Upper Kaskaskia River Watershed Total Maximum Daily Load and Load Reduction Strategies

Stage 1 Report – Public Review Draft

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Acronyms and Abbreviations

AFOs	animal feeding operations
AWQMN	Ambient Water Quality Monitoring Network
CAFO	confined animal feeding operation
CWA	Clean Water Act
HSG	hydrologic soil group
Illinois EPA	Illinois Environmental Protection Agency
IPCB	Illinois Pollution Control Board
LRS	load reduction strategy
MGD	millions of gallons per day
MS4	municipal separate storm sewer system
N/A	not applicable
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
STEPL	Spreadsheet Tool for the Estimation of Pollutant Load
STP	sewage treatment plant
TMDL	total maximum daily load
TP	total phosphorus
TSS	total suspended solids
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WQS	water quality standards
WWTP	wastewater treatment plant

1. Introduction

The Clean Water Act and U.S. Environmental Protection Agency (U.S. EPA) regulations require that Total Maximum Daily Loads (TMDLs) be developed for waters that do not support their designated uses. In simple terms, a TMDL is a plan to attain and maintain water quality standards in waters that are not currently meeting them. In addition to TMDL development, load reduction strategies (LRS) are included to address additional pollutants in the watershed that do not have water quality standards, namely nutrients and sediment in streams. This TMDL and LRS study addresses the approximately 1,568 square miles Upper Kaskaskia River watershed located in central Illinois. Several waters within the Upper Kaskaskia River watershed area have been placed on the State of Illinois 303(d) list, and require the development of a TMDL or LRS.

1.1 TMDL Development Process

The TMDL process establishes the allowable loading of pollutants or other quantifiable parameters for a water body based on the relationship between pollution sources and instream conditions. This allowable loading represents the maximum quantity of the pollutant that the waterbody can receive without exceeding water quality standards. The TMDL also takes into account a margin of safety, which reflects scientific uncertainty, as well as the effects of seasonal variation. By following the TMDL process, States can establish water quality-based controls to reduce pollution from both point and nonpoint sources, and restore and maintain the quality of their water resources (U.S. EPA 1991).

The Illinois EPA will be working with stakeholders to implement the necessary controls to improve water quality in the impaired waterbodies and meet water quality standards. It should be noted that the controls for nonpoint sources (e.g., agriculture) will be strictly voluntary.

1.2 Water Quality Impairments

Several waters within the Upper Kaskaskia River watershed have been placed on the State of Illinois §303(d) list (Table 1, Figure 1, and Figure 2) and require development of TMDLs or LRSs. This TMDL project is intended to address documented water quality problems in the Upper Kaskaskia River watershed.

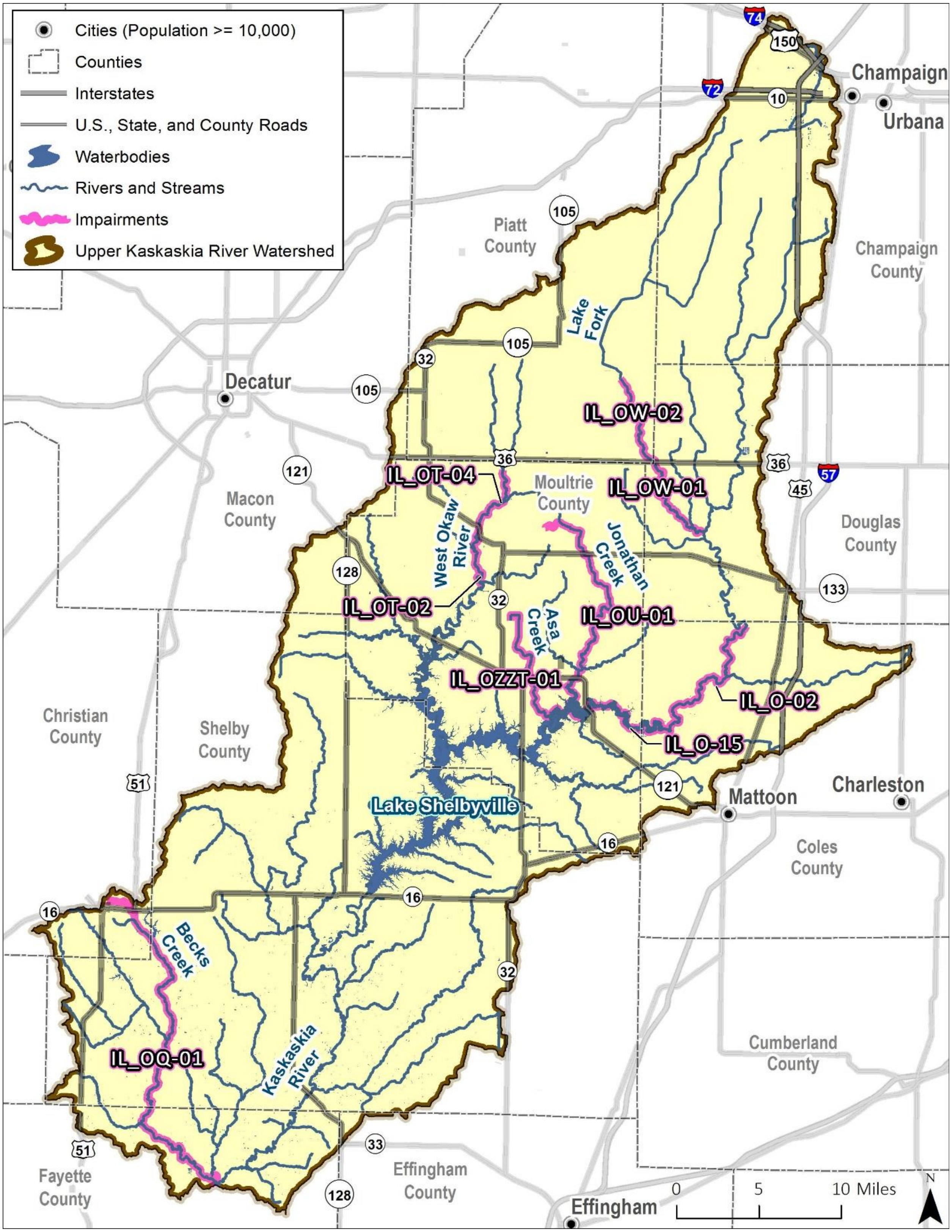

Figure 1. Upper Kaskaskia River watershed, TMDL/LRS project area.

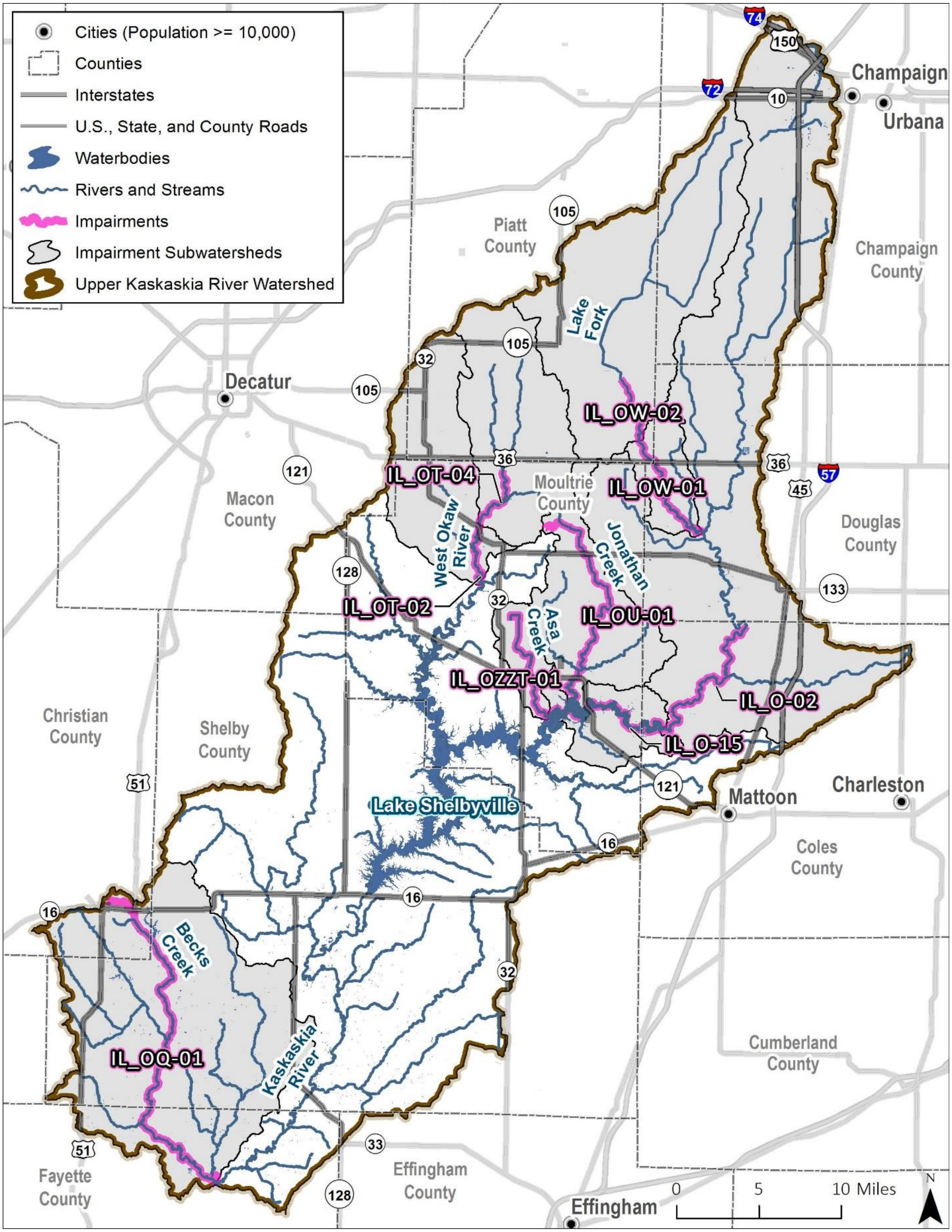

Figure 2. Upper Kaskaskia River watershed, TMDL/LRS impairment subwatersheds.

Table 1. Upper Kaskaskia River watershed impairments and pollutants (2014 Illinois 303(d) Draft List)

Name	Segment ID	Segment Length (Miles)	Watershed Area (Sq. Miles)	Designated Uses	TMDL Parameters	LRS Parameters
Kaskaskia River	IL_O-02	13.53	491	Primary contact recreation	Fecal coliform	-
Kaskaskia River	IL_O-15	13.85	519	Primary contact recreation	Fecal Coliform	-
Beck Creek	IL_OQ-01	29.8	204	Primary contact recreation	Fecal Coliform	--
West Okaw River	IL_OT-02	5.39	142	Primary contact recreation	Fecal Coliform	--
West Okaw River	IL_OT-04	5.07	76	Aquatic life	Dissolved Oxygen, pH	Total Phosphorus
Jonathon Creek	IL_OU-01	19.25	58	Primary contact recreation	Fecal Coliform	--
Lake Fork	IL_OW-01	9.72	171	Aquatic life	--	Sedimentation/Siltation
Lake Fork	IL_OW-02	4.91	150	Aquatic life	--	Sedimentation/Siltation
Asa Creek	IL_OZZT-01	9.22	15	Aquatic life	pH	Sedimentation/Siltation

2. Watershed Characterization

The Upper Kaskaskia River watershed is located in central Illinois (Figure 1 and Figure 2). The headwaters for the watershed begin near Champaign, IL. The Upper Kaskaskia River then flows through Shelbyville Lake in the central portion of the watershed and Beck Creek joins the river at the southern end of the watershed. Downstream of the watershed, the Kaskaskia River flows through Carlyle Lake and eventually joins the Mississippi River south of St. Louis, Missouri. The watershed covers nearly 1,568 square miles; major tributaries along this stretch of the river include the Lake Fork of Kaskaskia River, Johnathon Creek, Asa Creek, Whitley Creek, West Okaw River, Robinson Creek, Richland Creek and Beck Creek.

The U.S. Army Corps of Engineers is planning to begin a Feasibility Study during fall 2015 that will result in a comprehensive watershed plan that will help to restore, preserve, and protect the Kaskaskia River basin. The comprehensive plan will address improving water quality within the basin, amongst other priorities. This plan is anticipated to be competed in 2018.

2.1 Jurisdictions and Population

Counties with land located in the watershed area include Champaign, Christian, Coles, Douglas, Effingham, Fayette, Macon, Moultrie, Piatt and Shelby. A portion of the city of Champaign is located in the headwaters of the watershed and the city itself accounts for approximately half of the population of Champaign County. Champaign is the only major government unit with jurisdiction in the Upper Kaskaskia River watershed area. Populations are area weighted to the watershed in Table 2. The Champaign County population numbers were adjusted to only account for the portion of the city of Champaign in the watershed.

Table 2. Area weighted county populations within project area

County	2000	2010	Percent Change
Champaign	25,008	27,533	10%
Christian	905	890	-2%
Coles	12,632	12,793	1%
Douglas	5,767	5,783	0%
Effingham	179	178	0%
Fayette	1,879	1,908	2%
Macon	4,051	3,912	-3%
Moultrie	14,286	14,845	4%
Piatt	6,071	6,206	2%
Shelby	15,933	15,564	-2%
TOTAL	***86,710***	***89,613***	***3%***

Source: U.S. Census Bureau

2.2 Climate

Climate data are available from the National Oceanic and Atmospheric Administration (NOAA) Global Historical Climatology Network Database; Station USC00117876 is located at Shelbyville Dam, IL in the central portion of the watershed. Monthly data from 1941-2014 for precipitation and snowfall and 1973-2014 for temperature are summarized in Table 3. In general, the climate of the region is continental with hot, humid summers and cold winters. The average high winter temperature was 38.1 °F and the average high summer temperature was 85.2 °F. The annual average precipitation at Shelbyville Dam was approximately 38 inches, including approximately 10 inches of snowfall. In general, larger volumes of precipitation tend to occur between the months of April and September.

Table 3. Climate summary for Shelbyville Dam (1941-2014)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average High ºF	35	40	51	64	75	83	86	86	81	67	53	39
Average Low ºF	18	22	32	43	54	63	66	65	57	44	34	23
Mean Temperature ºF	27	31	41	54	64	73	76	76	69	55	43	31
Average Precipitation (in)	2.0	2.4	2.7	3.3	4.3	4.4	3.6	2.9	2.9	3.4	3.4	2.7
Average snowfall (in)	2.9	2.9	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	2.1

Source: NOAA Global Historical Climatology Network Database

2.3 Land Use and Land Cover

Land use in the watershed is heavily influenced by agriculture (Figure 3). There is a small amount of urban area surrounding Champaign and other small towns in the watershed. Land use within the watershed includes agriculture – cultivated crops and pasture/hay (approximately 80 percent), forest (approximately 10 percent), and urban (approximately 8 percent). Corn and soybeans are the most common crops, although wheat is also farmed in Shelby and Fayette counties. Table 4 presents area and percent by land cover type as provided in the 2011 National Land Cover Database (MLRC 2015). Table 5 summarizes land covers that are contributing to each of the impaired segments.

Table 4. Watershed land use summary

Land Use / Land Cover Category	Acres	Percentage
Cultivated Crops	747,974	74.5%
Deciduous Forest	100,864	10.0%
Hay/Pasture	57,469	5.7%
Developed, Open Space	40,779	4.1%
Developed, Low Intensity	31,399	3.1%
Open Water	13,357	1.3%
Developed, Medium Intensity	4,940	0.5%
Woody Wetlands	3,289	0.3%
Herbaceous	1,775	0.2%
Developed, High Intensity	1,446	0.1%
Emergent Herbaceous Wetlands	118	<0.1%
Barren Land	113	<0.1%
Evergreen Forest	107	<0.1%
Shrub/Scrub	1	<0.1%
Total	**1,003,631**	**100.0%**

Source: 2011 National Land Cover Database

Table 5. Land use by impaired segment

Watershed	Segment	Watershed Area (square miles)	Cultivated Crops	Pasture /Hay	Developed	Forest	Grassland/ Herbaceous/ Shrub/Scrub	Barren Land	Wetlands and Water
			%						
Kaskaskia River	IL_O-02	491	91.4	1.2	6.1	1.2	0	0	0.1
Kaskaskia River	IL_O-15	519	85.1	2.7	9.5	2	0.1	0	0.6
Beck Creek	IL_OQ-01	204	51.7	15.9	7.7	23.7	0.3	0	0.7
West Okaw River	IL_OT-02	142	91.4	1.2	6.1	1.2	0	0	0.1
West Okaw River	IL_OT-04	76	92.8	1	5.6	0.5	0	0	0.1
Jonathon Creek	IL_OU-01	58	87.8	4.5	5.3	2.1	0.1	0	0.2
Lake Fork	IL_OW-01	171	92	1	6.1	0.6	0	0	0.3
Lake Fork	IL_OW-02	150	93.5	0.5	5.7	0.2	0	0	0.1
Asa Creek	IL_OZZT-01	15	76.5	1.6	20.4	1.3	0.2	0	0

Source: 2011 National Land Cover Database

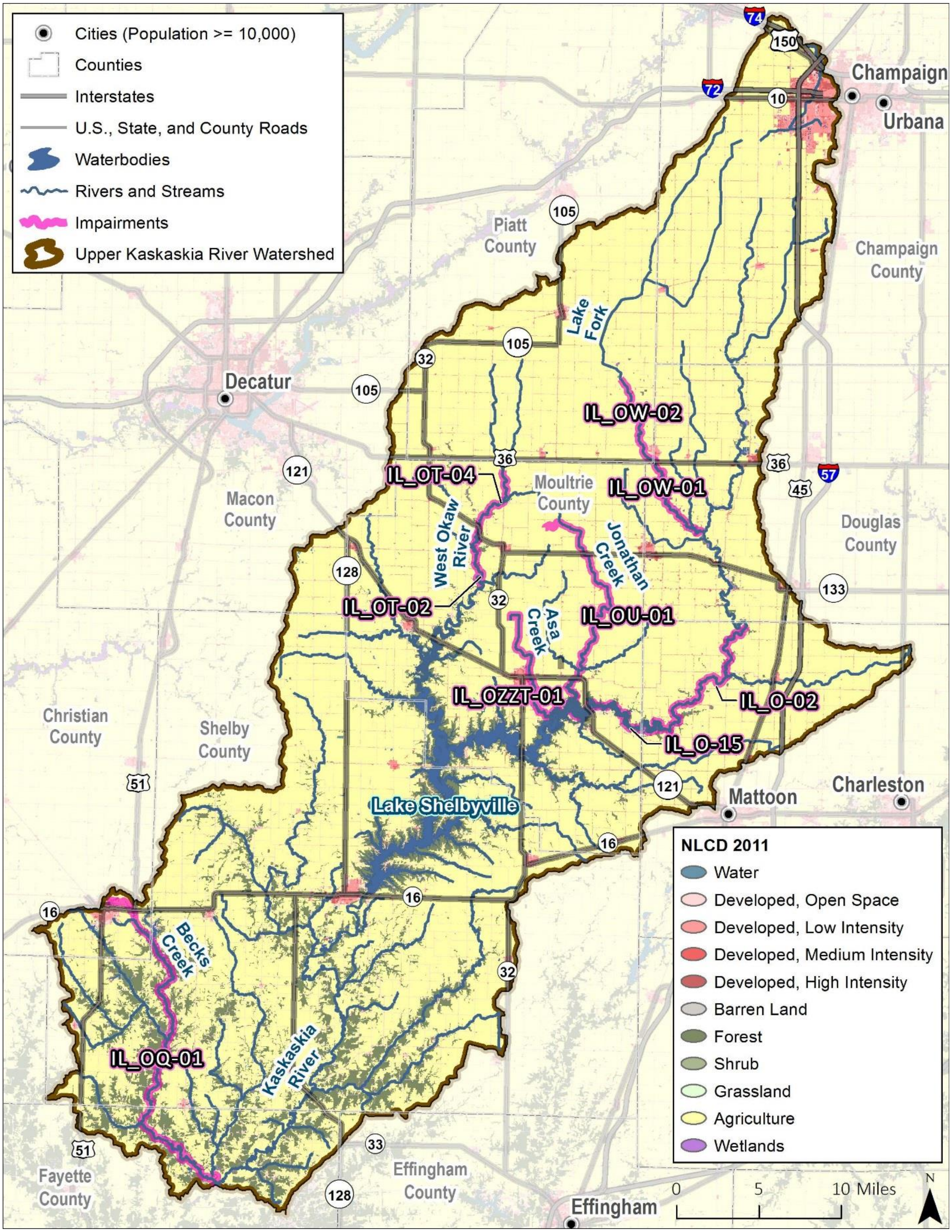

Figure 3. Upper Kaskaskia River watershed land cover (2011 National Land Cover Database).

2.4 Topography

Topography is an important factor in watershed management because stream types, precipitation, and soil types can vary dramatically by slope and elevation. The Upper Kaskaskia River watershed varies in elevation from 486 to 857 feet (Figure 4). The Upper Kaskaskia River water elevation varies from 810 feet to 600 feet and is 75 miles long upstream of Shelbyville Lake and water elevation varies from 560 feet to 498 feet and is 39 miles long downstream of Shelbyville Lake, resulting in an upper watershed stream gradient of 2.8 feet per mile and lower watershed stream gradient of 1.6 feet per mile.

2.5 Soils

The National Cooperative Soil Survey publishes soil surveys for each county within the U.S. These soil surveys contain predictions of soil behavior for selected land uses. The surveys also highlight limitations and hazards inherent in the soil, general improvements needed to overcome the limitations, and the impact of selected land uses on the environment. The soil surveys are designed for many different uses, including land use planning, the identification of special practices needed to ensure proper performance, and mapping of hydrologic soil groups (HSGs).

HSGs refer to the grouping of soils according to their runoff potential. Soil properties that influence the HSGs include depth to seasonal high water table, infiltration rate and permeability after prolonged wetting, and depth to a slower permeable layer (e.g., finer grained). There are four groups of HSGs: Group A, B, C, and Group D. Table 6 describes those HSGs found in the Upper Kaskaskia River project area. Figure 5 and Table 7 summarizes the composition of HSGs per watershed. Soils are predominantly B and B/D in the upper part of the watershed and transition to C and D type soils below Shelbyville Lake. The high proportion of B/D type soils coupled with agricultural land uses indicate the likelihood of tile drainage.

Table 6. Hydrologic soil group descriptions

HSG	Group Description
A	Sand, loamy sand or sandy loam types of soils. Low runoff potential and high infiltration rates even when thoroughly wetted. Consist chiefly of deep, well to excessively drained sands or gravels with a high rate of water transmission.
B	Silt loam or loam. Moderate infiltration rates when thoroughly wetted. Consist chiefly or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.
C	Soils are sandy clay loam. Low infiltration rates when thoroughly wetted. Consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure.
D	Soils are clay loam, silty clay loam, sandy clay, silty clay or clay. Group D has the highest runoff potential. Low infiltration rates when thoroughly wetted. Consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material.
A-C/D	Dual Hydrologic Soil Groups. Certain wet soils are placed in group D based solely on the presence of a water table within 24 inches of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. The first letter applies to the drained condition and the second to the undrained condition.

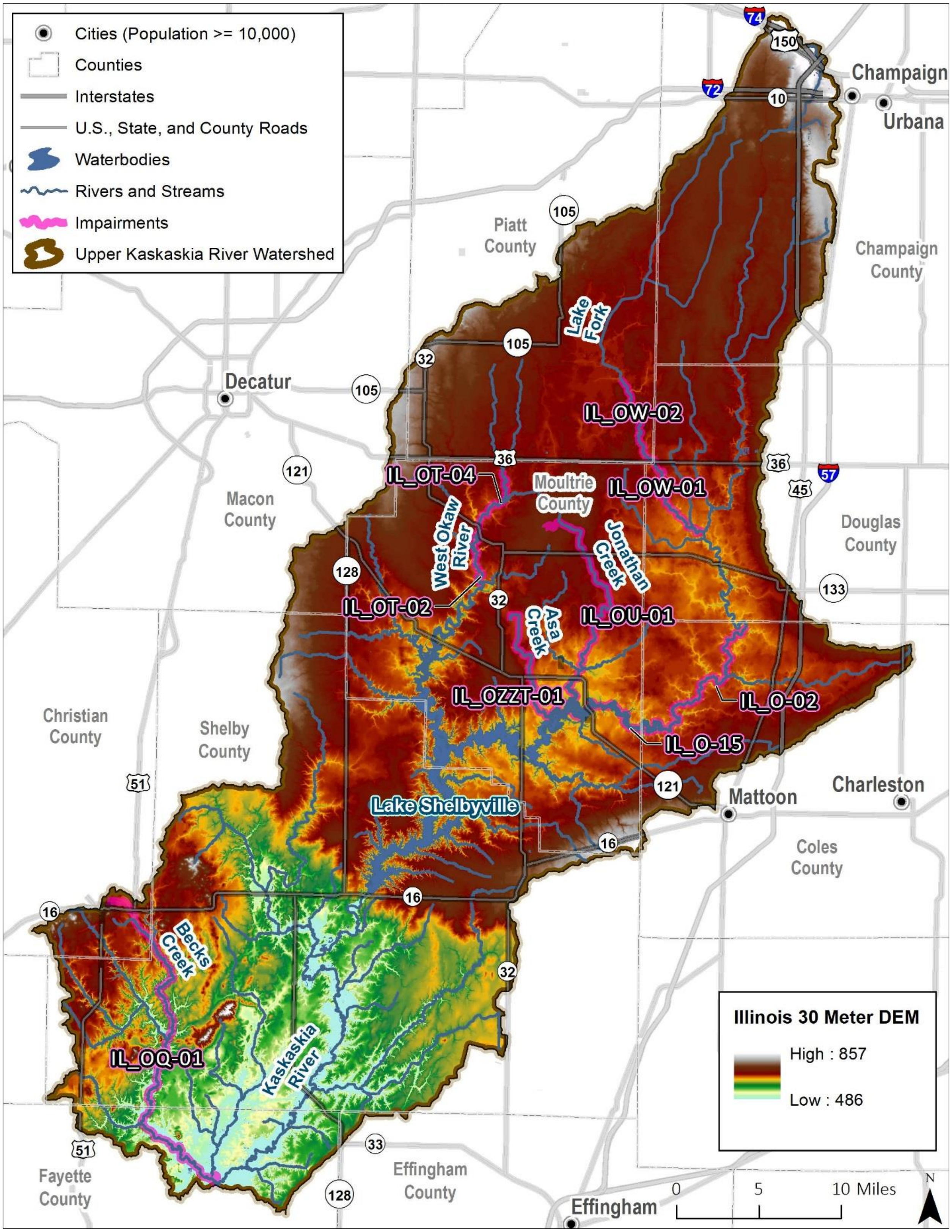

Figure 4. Upper Kaskaskia River watershed land elevations (ISGS 2003).

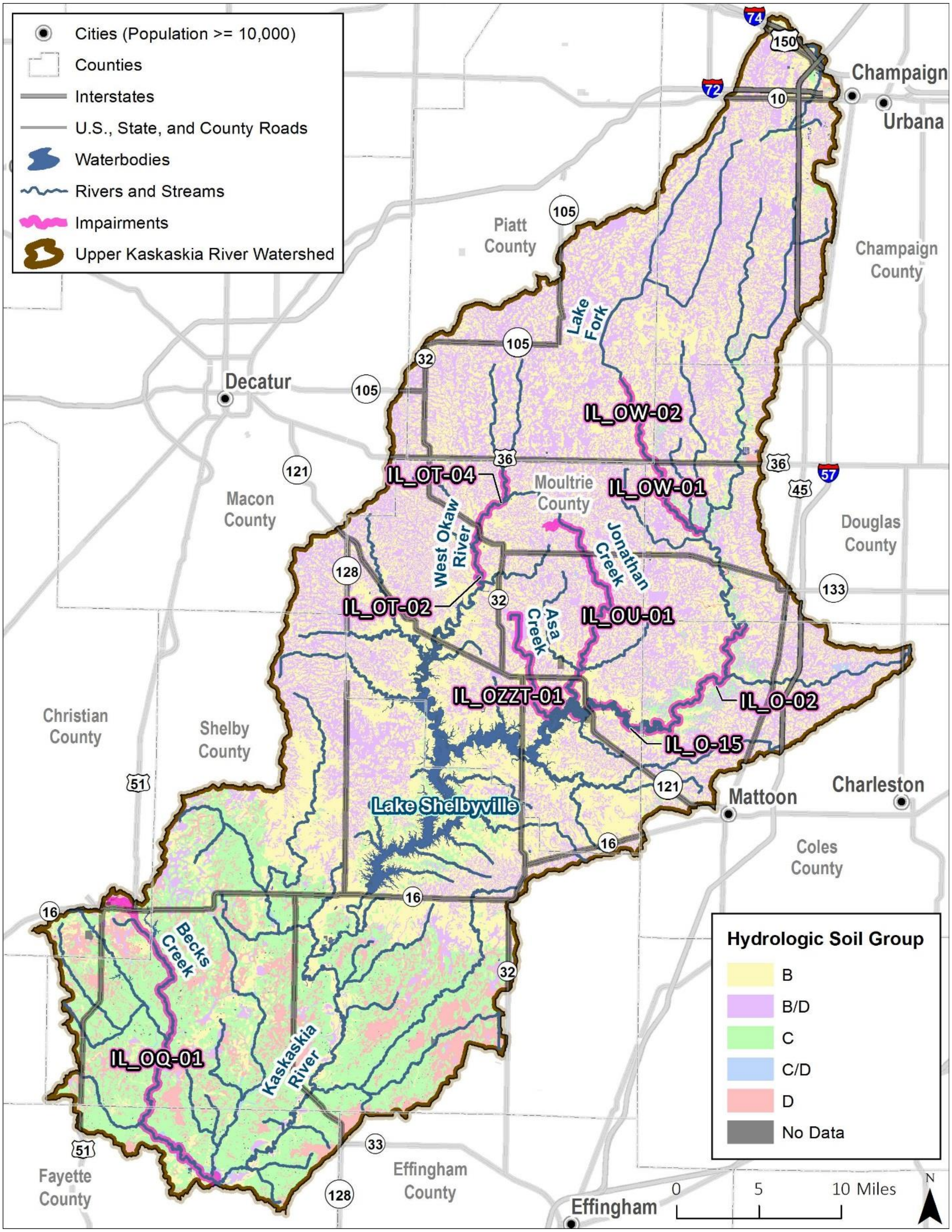

Figure 5. Upper Kaskaskia River watershed hydrologic soil groups (Soil Surveys for Champaign, Christian, Coles, Douglas, Fayette, Macon, Moultrie, Piatt and Shelby Counties, Illinois; NRCS SSURGO Database 2011).

Table 7. Percent composition of hydrologic soil group per watershed

Watershed	Segment	B	B/D	C	C/D	D	No Data
		%					
Kaskaskia River	IL_O-02	47.4	48.5	2.6	0.5	0.8	0.2
Kaskaskia River	IL_O-15	48.4	47.3	2.7	0.5	0.8	0.3
Beck Creek	IL_OQ-01	13.1	4.7	58.8	1.1	21.7	0.6
West Okaw River	IL_OT-02	48.6	51.1	0	0.3	0	0
West Okaw River	IL_OT-04	46	53.7	0	0.3	0	0
Jonathon Creek	IL_OU-01	51.9	47.4	0.1	0.3	0.2	0.1
Lake Fork	IL_OW-01	47.4	50.7	1	0.4	0.5	0
Lake Fork	IL_OW-02	47.7	51.9	0.1	0.3	0	0
Asa Creek	IL_OZZT-01	57.6	42.3	0	0	0	0.1

Source: NRCS SSURGO Database 2011

A commonly used soil attribute is the K-factor. The K-factor:

> *indicates the susceptibility of a soil to sheet and rill erosion by water. (The K-factor) is one of six factors used in the Universal Soil Loss Equation to predict the average annual rate of soil loss by sheet and rill erosion. Losses are expressed in tons per acre per year. These estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water (NRCS 2005).*

The distribution of K-factor values in the Upper Kaskaskia River watershed range from 0.17 to 0.55, with an average value of 0.35 (Figure 6).

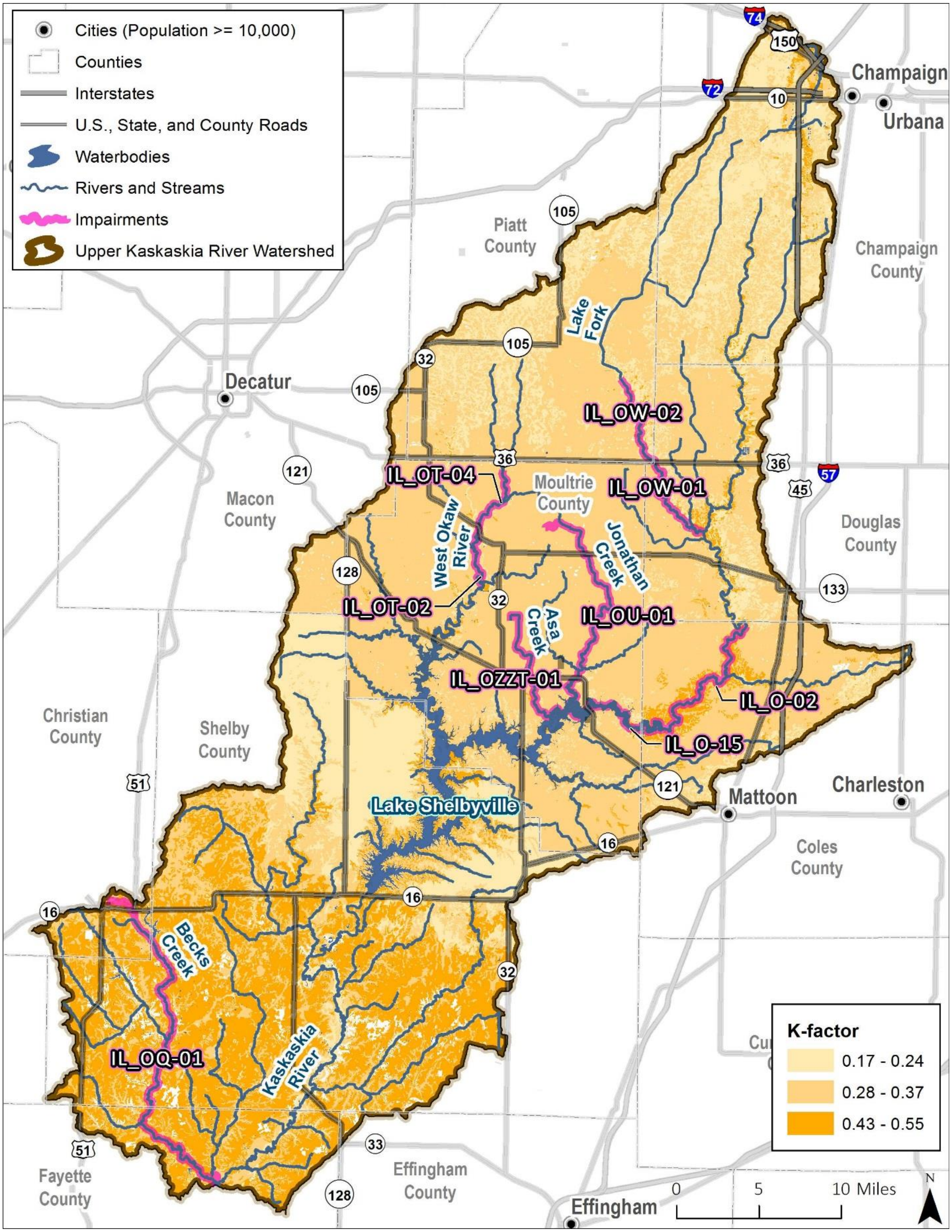

Figure 6. Upper Kaskaskia River watershed soil K-factor values (Soil Surveys for Champaign, Christian, Coles, Douglas, Fayette, Macon, Moultrie, Piatt and Shelby Counties, Illinois; NRCS SSURGO Database 2011).

2.6 Hydrology and Water Quality

Hydrology plays an important role in evaluating water quality. The hydrology of the Upper Kaskaskia River watershed is driven by local climate conditions and the landscape. The U.S. Geological Survey (USGS) has been collecting flow and water quality data in this watershed since the 1940s, while Illinois EPA has been collecting water quality data since the early 1970s.

2.6.1 USGS Flow Data

The USGS has monitored flow at several locations in the watershed (Table 8 and Figure 7). The daily average, peak history, and monthly flow data show the inherent variability associated with hydrology. Flow duration curves provide a way to address that variability and flow related water quality patterns. Duration curves describe the percentage of time during which specified flows are equaled or exceeded. Flow duration analysis looks at the cumulative frequency of historic flow data over a specified period, based on measurements taken at uniform intervals (e.g., daily average or 15-minute instantaneous). Duration analysis results in a curve that relates flow values to the percent of time those values have been met or exceeded. Low flows are exceeded a majority of the time, whereas floods are exceeded infrequently. Flow duration curves for the active USGS gages are presented in Figure 8.

Table 8. USGS stream gages within project area

Gage ID	Watershed Area *(mi.^{2})*	Location	Period of Record	Impaired Segment
05590000	12.4	Kaskaskia Ditch at Bondville, IL	1948-1990	-
05590050	**8**	**Copper Slough at Champaign, IL**	**2005-2015**	**-**
05590400	109	Kaskaskia River near Pesotum, IL	1964-1979	-
05590420	113	Kaskaskia River near Tuscola, IL	1979-1997[a]	-
05590520	**124.4**	**Kaskaskia River below Ficklin, IL**	**2012-2015**	**-**
05590800	**149**	**Lake Fork at Atwood, IL**	**1972-2015**	**IL_OW-01**
05590950	**358**	**Kaskaskia River at Chesterville, IL**	**1995-2015**	**-**
05591200	**473**	**Kaskaskia River at Cooks Mill, IL**	**1970-2015**	**IL_O-02**
05591300	506	Kaskaskia River at Allenville, IL	1980-1997[a]	IL_O-15
05591400	54.7	Johnathon Creek near Sullivan, IL	1980-1997[a]	IL_OU-01
05591500	8	Asa Creek at Sullivan, IL	1950-1997	IL_OZZT-01
05591550	**34.6**	**Whitley Creek near Allenville, IL**	**1980-2015**	**-**
05591700	**112**	**West Okaw River Near Lovington, IL**	**1980-2015**	**IL_OT-02**
05592000	**1,054**	**Kaskaskia River at Shelbyville, IL**	**1940-2015**	**-**
05592050	**93.1**	**Robinson Creek near Shelbyville, IL**	**1979-2015**	**-**
05592100	**1,330**	**Kaskaskia River near Cowden, IL**	**1970-2015**	**-**
05592195	97	Beck Creek at Herrick, IL	1979-2013	IL_OQ-01

BOLD – indicates active USGS gage
a. Water quality data only, no flow data available

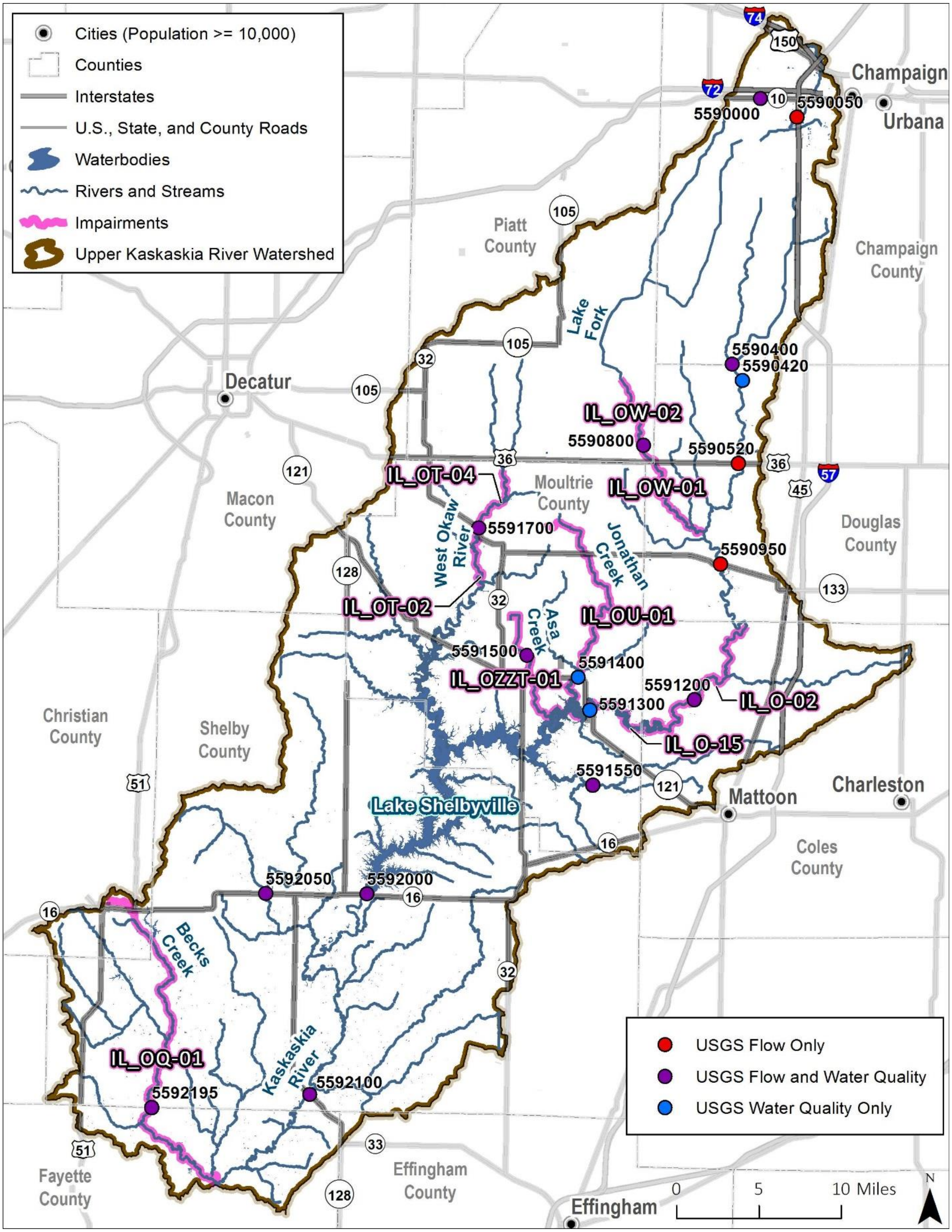

Figure 7. USGS stream gages within watershed.

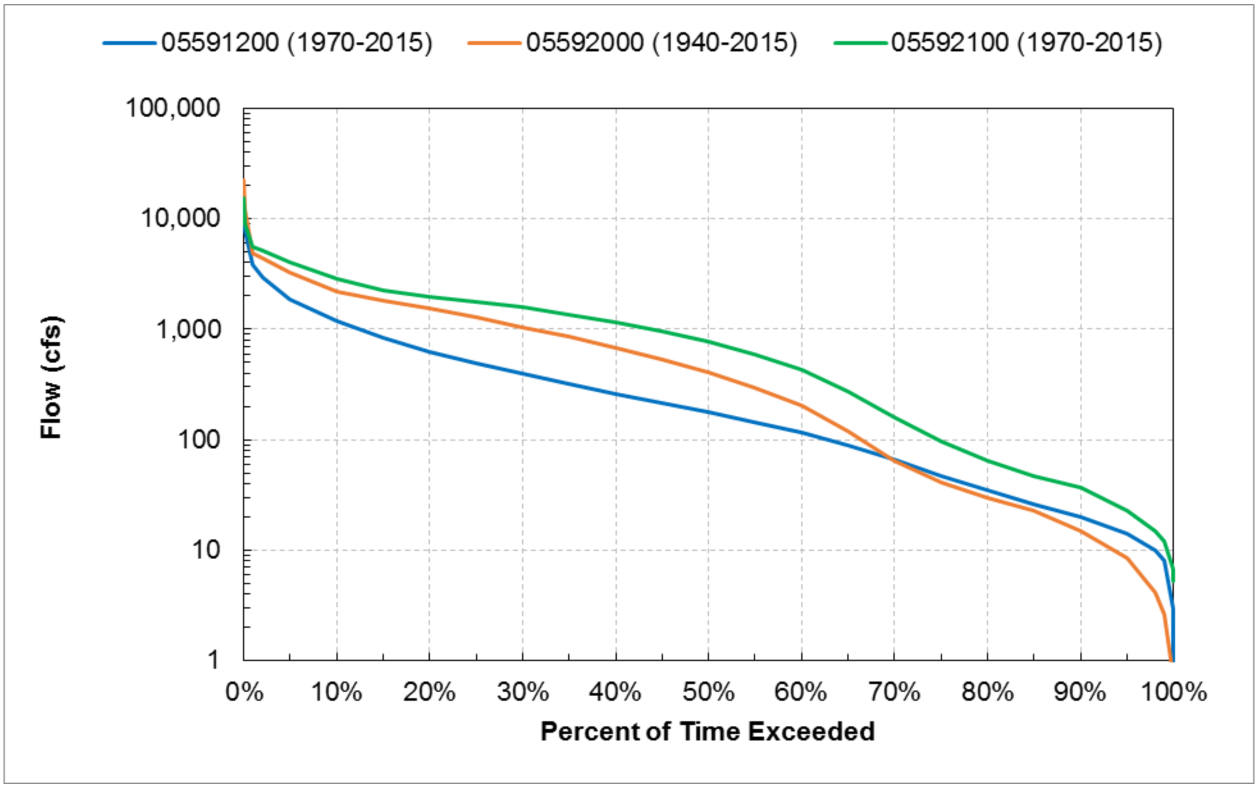

Figure 8. Flow duration curves for three active USGS gages in the Upper Kaskaskia River watershed area. Moderation of flows due to the Shelbyville Dam is clear at gages 05592000 and 05592100; both sites are located downstream of the reservoir.

An evaluation of annual flow at USGS gages 05591200, 05592000 and 05592100 on the Upper Kaskaskia River from 1970 to 2015, 1940 to 2015 and 1970-2015, respectively showed that annual flow in 2001 was nearly at the median; thus, it is assumed that 2001 is a typical year. Flow at USGS gages 05591200, 05592000 and 05592100 are plotted with precipitation from the NOAA Global Historical Climatology Network Database Station USC00117876 (Shelbyville Dam) in Figure 9. Moderation of flows due to Shelbyville Dam is clear at gage 0559200.

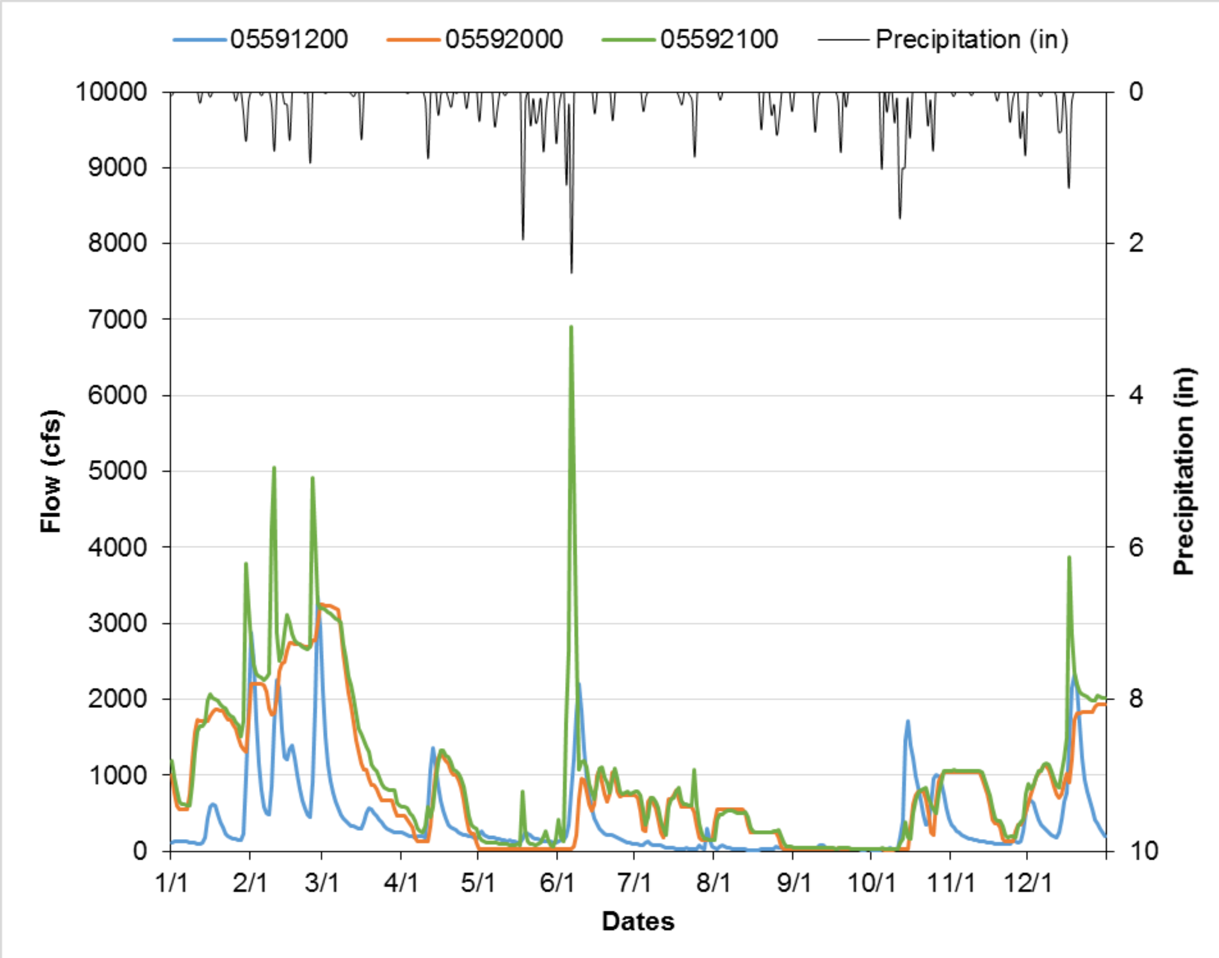

Figure 9. Daily flow in the Upper Kaskaskia River with daily precipitation at Shelbyville Dam (USC00117876), 2001.

2.6.2 Illinois EPA Water Quality Monitoring

Routine water quality monitoring is a key part of the Illinois EPA assessment program. The goals of Illinois EPA surface water monitoring programs are to determine whether designated uses are supported, identify causes of pollution (toxics, nutrients, sedimentation) and sources (point or nonpoint) of surface water impairments, determine the overall effectiveness of pollution control programs, and identify long term resource quality trends. Illinois EPA has operated a widespread, active long-term monitoring network in Illinois since 1977, known as the Ambient Water Quality Monitoring Network (AWQMN). The AWQMN is utilized by the Illinois EPA to provide baseline water quality information, to characterize and define trends in the physical, chemical and biological conditions of the state's waters, to identify new or existing water quality problems, and to act as a triggering mechanism for special studies or other appropriate actions.

Additional uses of the data collected by the Illinois EPA through the AWQMN program include the review of existing water quality standards and establishment of water quality based effluent limits for NPDES permits. The AWQMN is integrated with other Illinois EPA chemical and biological stream monitoring programs including Intensive River Basin Surveys, Facility –Related Stream Surveys, Fish Contaminant Monitoring, Toxicity Testing Program and Pesticide Monitoring Subnetwork which are more regionally based (specific watersheds or point source receiving stream) and cover a shorter span of time (e.g. one year) to evaluate compliance with water quality standards and determine designated use support. Information from this program is compiled by Illinois EPA into a biennial report, known as the Illinois Integrated Water Quality Report and Section 303(d) List, required by the Federal Clean Water Act.

Within the Upper Kaskaskia River project area, data were found for numerous stations that are part of AWQMN (Figure 10 and Table 9). Parameters sampled on the streams include field measurements (e.g., water temperature) as well as those that require lab analyses (e.g., fecal coliform, nutrients, and total suspended solids). Many sites have historical data that are greater than 10 years old. Data were obtained directly from Illinois EPA.

Additional water quality data are also available at several USGS stations (Figure 7 and Table 9). Parameters sampled include suspended and dissolved solids, nutrients, dissolved oxygen, turbidity, fecal coliform, and metals.

Table 9. Upper Kaskaskia River watershed water quality data

Water Body	Impaired Segment	AWQMN Sites (USGS Gage)	Location	Period of Record
Kaskaskia River	O-02	O-02 (05591200)	RM 238.1 CO Rd. 300E Br. at Cooks Mills	*1970-1997*, *1999*-2013
	O-15	O-15 (05591300)	RM 224.4, RT 121 Br. 1 Mi. N of Allenville	*1980-1997*, *1999*-2007, 2012
Beck Creek	OQ-01	OQ-01 (05592195)	CO Rd. 3300N Br. 2 Mi. W of Herrick	*1979*-2013
West Okaw River	OT-04	-- (05591700)	West Okaw River near Lovington, IL	*1980-1997*
	OT-02	OT-02	CR 2200N Br., 0.5 Mi. W of SR 32 and 1.5 Mi. NW of Lovington	*1999*-2007
Jonathon Creek	OU-01	OU-01 (05591400)	RT 121 Br. 2.5 Mi. E of Sullivan	*1980-1997*, *1999*-2007, 2012
Lake Fork	OW-02	-- (05590800)	Lake Fork at Atwood, IL	*1972-1983*
	OW-01	OW-01	RT 36 Br. at Atwood	*2002*, 2007, 2012
	OW-02	OW-03	5 Mi. NW Atwood	2007
Asa Creek	OZZT-01	OZZT-01 (05591500)	Hamblin Rd. (1100E) Br., 0.2 Mi. S of CR 1500N and 0.8 Mi. N of Sullivan	*1964-1997,1999*-2007

Italics – Data are greater than 10 years old
RM – River Mile
DNS – Downstream
STP – Sewage treatment plant

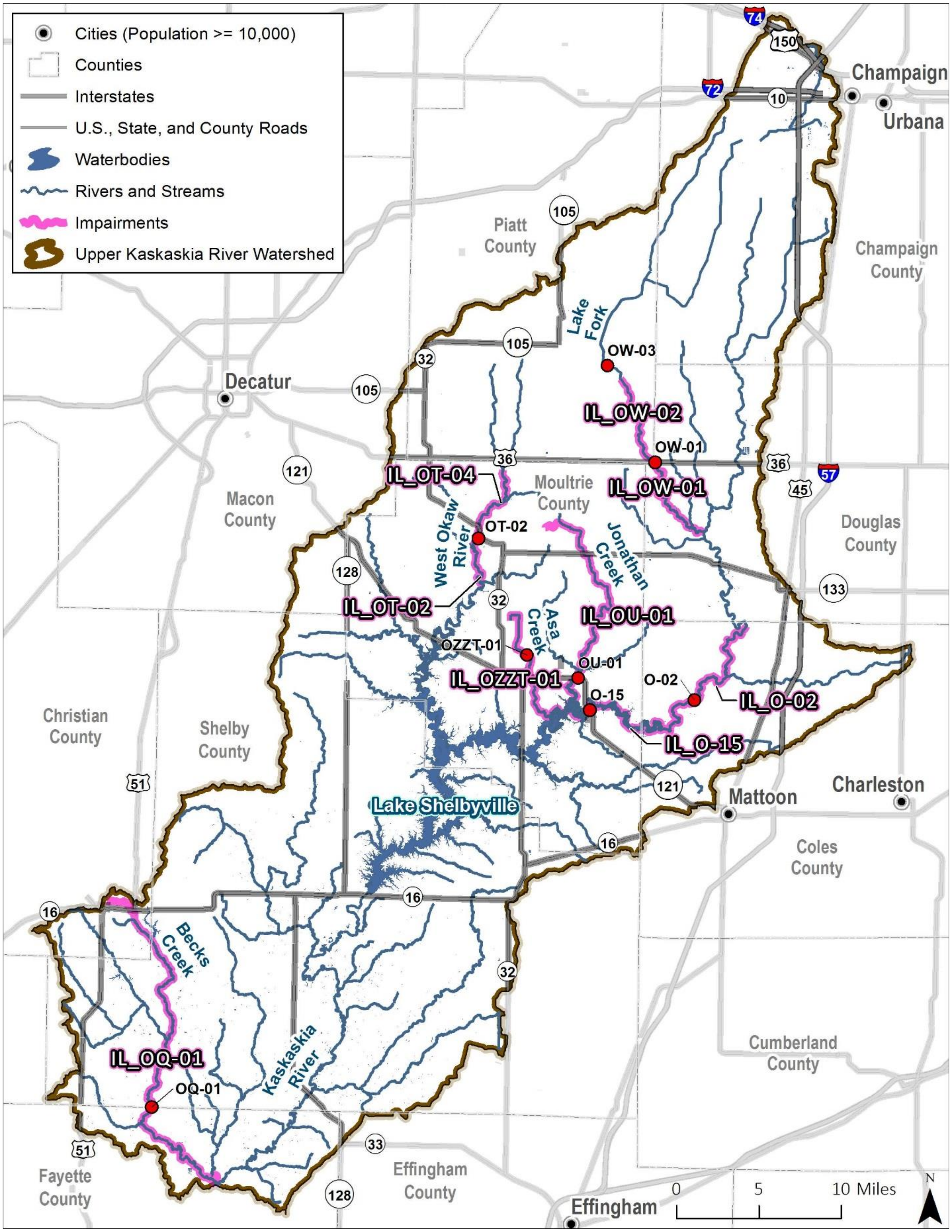

Figure 10. Illinois EPA water quality sampling sites within watershed.

3. Watershed Source Assessment

Source assessments are an important component of water quality management plans and TMDL/LRS development. This section provides a summary of potential sources that contribute listed pollutants to the Upper Kaskaskia River watershed.

3.1 Pollutants of Concern

Pollutants of concern evaluated within this source assessment include fecal coliform, phosphorus, and sediment. In addition to these pollutants, low dissolved oxygen and pH impairments are often linked to biochemical oxygen demand and ammonia in streams. These pollutants can originate from an array of sources including point and nonpoint sources. Point sources typically discharge at a specific location from pipes, outfalls, and conveyance channels. Nonpoint sources are diffuse sources that have multiple routes of entry into surface waters, particularly overland runoff. This section provides a summary of potential point and nonpoint sources that contribute pollutants to the impaired waterbodies.

3.2 Point Sources

Point source pollution is defined by the Federal Clean Water Act (CWA) §502(14) as:

> *"any discernible, confined and discrete conveyance, including any ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation [CAFO], or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agriculture storm water discharges and return flow from irrigated agriculture."*

Point sources can include facilities such as municipal wastewater treatment plants (WWTPs), industrial facilities, CAFOs, or regulated storm water including municipal separate storm sewer systems (MS4s). There are no permitted CAFOs in the watershed. Under the CWA, all point sources are regulated under the NPDES program. NPDES permit holders in the watershed are discussed below.

3.2.1 NPDES Facilities (Non-Stormwater)

A municipality, industry, or operation must apply for an NPDES permit if an activity at that facility discharges wastewater to surface water. Examples of NPDES facilities within the study area include municipal and industrial wastewater treatment plants. Bacteria and nutrients can be found in these discharges. In addition, permitted facilities can contribute to low dissolved oxygen and pH impairments.

There are 16 individual NPDES permitted facilities that drain to impaired waters. Table 10 and Figure 11 includes each NPDES permitted facility within the watershed. Average and maximum design flows and downstream impairments are included in the facility summaries. Note that there are additional NPDES permitted facilities in the watershed, but these do not discharge or drain to an impaired water.

Eleven WWTPs have disinfection exemptions in the watershed which allow a facility to discharge wastewater without disinfection. Facilities with disinfection exemptions may be required to provide Illinois EPA with updated information to demonstrate compliance with these requirements and facilities directly discharging into a fecal-impaired segment may have their disinfection exemption revoked through future NPDES permitting actions.

Table 10. Individual NPDES permitted facilities discharging to impaired segments

IL Permit ID	Facility Name	Type of Discharge	Receiving Water	Downstream Impairment(s)	Average Design Flow (MGD)	Maximum Design Flow (MGD)	Disinfection Exemption
IL0000141	EQUISTAR CHEMICALS, LP-TUSCOLA	Mix of sanitary, industrial ,and stormwater	UNNAMED TRIB TO KASKASKIA RIVER	O-02, O-15	3.0	12.2	Yes
IL0000221	PANHANDLE EASTERN-TUSCOLA	Groundwater infiltration and stormwater	KASKASKIA RIVER	O-02, O-15	0.01254	--	-- [a]
IL0004227	KRAFT FOODS GLOBAL-CHAMPAIGN	Stormwater and non-contact cooling water	COPPER SLOUGH	O-02, O-15	0.289	--	-- [a]
IL0021741	ARTHUR, VILLAGE OF	STP	KASKASKIA RIVER	O-02, O-15	0.5	1.25	Yes
IL0021806	SULLIVAN STP	STP	ASA CREEK-KASKASKIA RIVER	OZZT-01	0.75	0.75	Yes
IL0022314	PANA, CITY OF	STP	COAL CREEK (KASKASKIA BASIN)	OQCA-01	1.17	3.13	Yes
IL0024210	LOVINGTON STP	STP	UNNAMED TRIB-WEST OKAW RVR-KASK RVR	OT-02	0.2	0.5	Yes
IL0025097	ATWOOD, VILLAGE OF	STP	LAKE FORK BRANCH OF KASKASKIA RIVER	OW-01	0.2	0.5	Yes
IL0027197	VILLAGE OF HAMMOND	STP	HAMMOND MUTUAL DITCH	OT-04, OT-02	0.07	0.175	-- [a]
IL0031526	URBANA-CHAMPAIGN SD SW STP	STP	COPPER SLOUGH	O-02, O-15	7.98	17.25	Yes
IL0032549	BEMENT, VILLAGE OF	STP	UNNAMED TRIB OF W BRANCH LAKE FORK	OW-02	0.176	0.480	Yes
IL0062812	MARATHON PETROLEUM-CHAMPAIGN	Hydrostatic test water and stormwater	UNNAMED DITCH	O-02, O-15	0.0135	--	-- [a]
IL0066672	OAK TERRACE SANITARY SYSTEM INC	STP	UNNAMED TRIB OF COAL CREEK	OQCA-01	0.09	0.36	Yes
IL0067202	COMMERICAL FLOORING, INC	Treated sanitary waste and water soften backwash	UNNAMED STREAM TRIB TO KASKASKIA RV	O-02, O-15	0.008	--	Yes
ILG580051	HUMBOLT, VILLAGE OF	STP	FLAT BRANCH	O-02, O-15	0.07	0.175	Yes
ILG640209	IVESDALE, VILLAGE OF	Public water supply	EAST LAKE FORK OF KASKASKIA RIVER	OW-02	--	--	-- [a]

STP – Sewage treatment plant
MGD – Million gallons per day
a. No fecal coliform limit in current permit

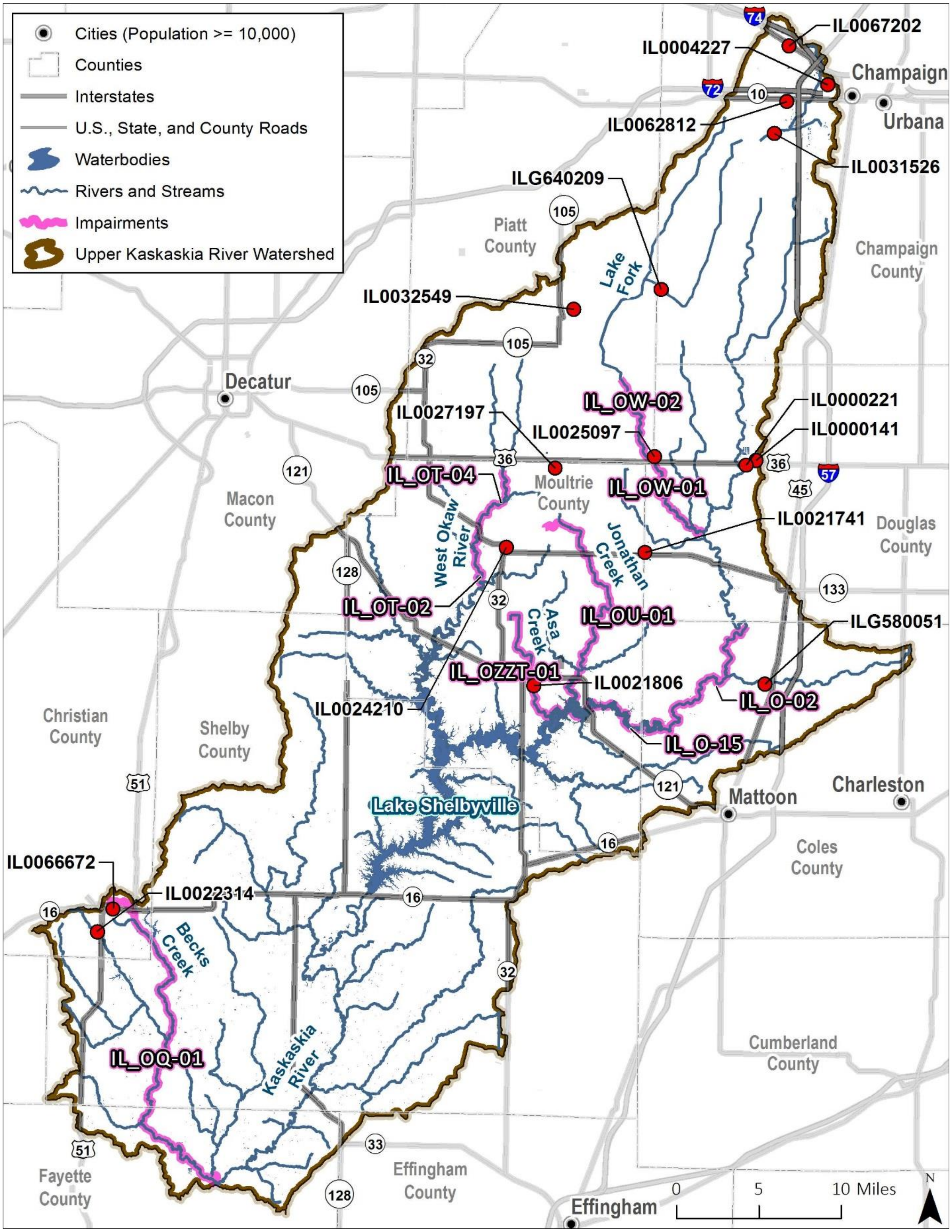

Figure 11. NPDES permitted facilities upstream of impaired segments.

3.2.2 Municipal Separate Storm Sewer Systems

Regulated storm water runoff can contribute to impairments in the project area. As development increases in the watershed, additional pressure will be placed on receiving waters due to storm water. Impervious areas associated with developed land uses can result in higher peak flow rates, higher runoff volumes and larger pollutant loads. Storm water runoff often contains sediment, nutrients, and bacteria amongst other pollutants.

Under the NPDES program, municipalities serving populations over 100,000 people are considered Phase I MS4 communities. Within the project area, there are no Phase I communities. Municipalities serving populations under 100,000 people are considered Phase II communities. Within Illinois, Phase II communities are allowed to operate under the statewide General Storm Water Permit (ILR40) which requires dischargers to file a Notice of Intent, acknowledging that discharges shall not cause or contribute to a violation of water quality standards.

To assure pollution is controlled to the maximum extent practical, regulated entities operating under the General Storm Water Permit (ILR40) are required to implement six control measures including public education, public involvement, illicit discharge and detection programs, control of construction site runoff, post construction storm water management in new development and redevelopment, and pollution prevention/good housekeeping for municipal operations. Regulated entities operating under the General Storm Water Permit within the watershed area are identified in Table 11 and Figure 12.

Table 11. Permitted MS4s

Permit ID	Regulated Entity	Receiving Waters
ILR400313	City of Champaign	Kaskaskia River (IL_O-02 & IL_O-15)
ILR400256	Champaign County (road authority)	Kaskaskia River (IL_O-02 & IL_O-15)
ILR400026	Champaign Township	Kaskaskia River (IL_O-02 & IL_O-15)
ILR400621	Village of Bondville	Kaskaskia River (IL_O-02 & IL_O-15)
ILR400493	Illinois Department of Transportation (road authority)	Kaskaskia River (IL_O-02 & IL_O-15)

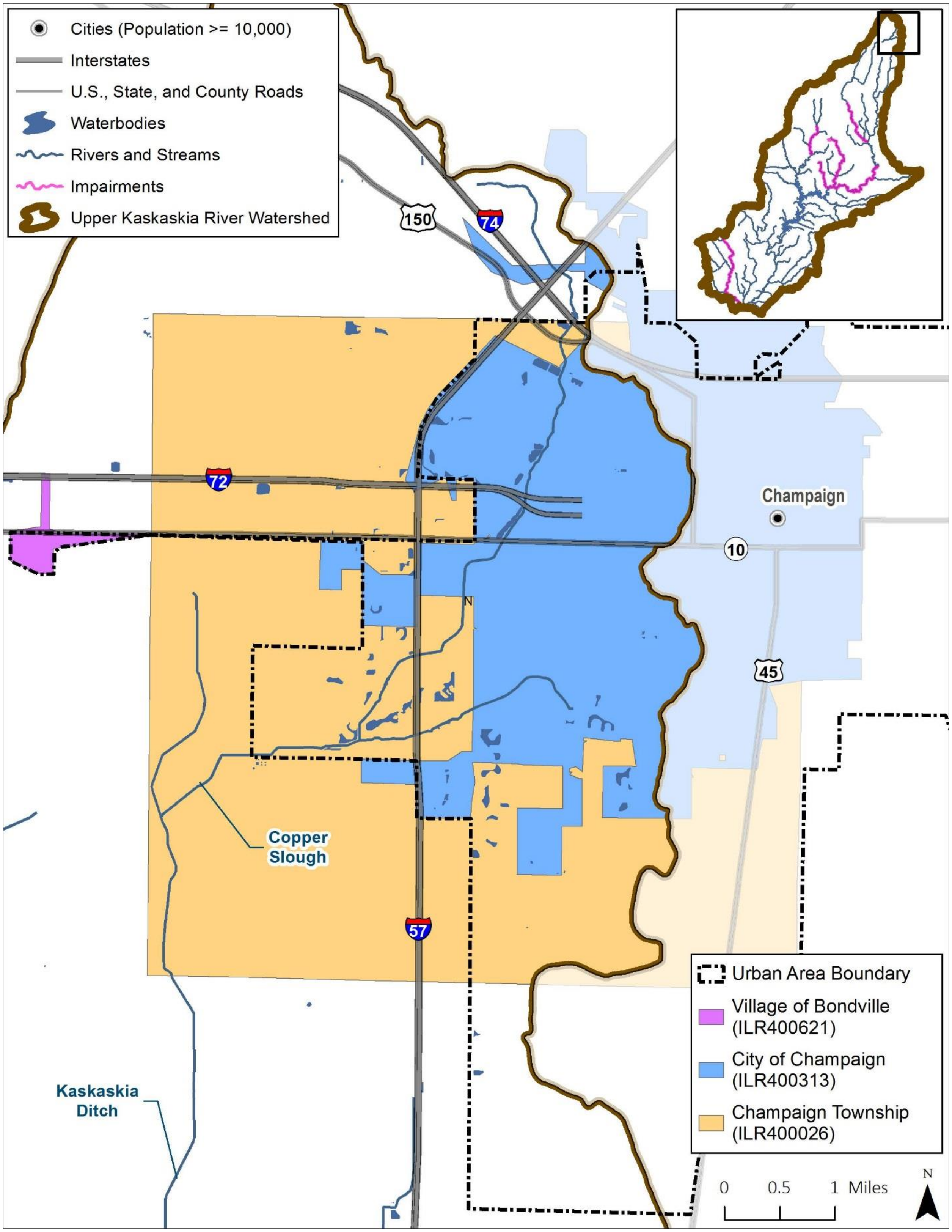

Figure 12. Regulated MS4s within the Upper Kaskaskia River watershed.
Champaign County and ILDOT are also regulated MS4s.

3.3 Nonpoint Sources

The term nonpoint source pollution is defined as any source of pollution that does not meet the legal definition of point sources. Nonpoint source pollution typically results from overland stormwater runoff that is diffuse in origin, as well as background conditions. It should be noted that stormwater collected and conveyed through a regulated MS4 is considered a controllable point source. With agricultural practices such as crop cultivation (74 percent) and pasture/hay (6 percent) covering an estimated 80 percent of the project area, nonpoint source pollution may contribute a significant amount of the total pollutant load. In addition to runoff and erosion, significant nonpoint sources also include septic systems and animal agriculture. Illinois EPA has identified several sources as contributing to the Upper Kaskaskia River watershed impairments (Table 12).

Table 12. Potential sources in project area based on the Draft 2014 305(b) list

Watershed	Segment	Causes	Sources
Kaskaskia River	IL_O-02	Fecal Coliform	Source Unknown
Kaskaskia River	IL_O-15	Fecal Coliform	Source Unknown
Beck Creek	IL_OQ-01	Fecal Coliform	Source Unknown
West Okaw River	IL_OT-02	Fecal Coliform	Source Unknown
West Okaw River	IL_OT-04	Dissolved Oxygen, pH and Phosphorus (Total)	Crop Production (Crop Land or Dry Land) and Source Unknown
Jonathon Creek	IL_OU-01	Fecal Coliform	Source Unknown
Lake Fork	IL_OW-01	Alteration in stream-side or littoral vegetative covers and Sedimentation/Siltation	Channelization, Crop Production (Crop Land or Dry Land), and Source Unknown
Lake Fork	IL_OW-02	Alteration in stream-side or littoral vegetative covers and Sedimentation/Siltation	Channelization, Crop Production (Crop Land or Dry Land), and Source Unknown
Asa Creek	IL_OZZT-01	Sedimentation/Siltation and pH	Source Unknown

a. Mercury and polychlorinated biphenyls are also causes of impairments for several segments; these causes and their sources are not addressed in this report.

3.3.1 Stormwater Runoff

During wet-weather events (snowmelt and rainfall), pollutants are incorporated into runoff and can be delivered to downstream waterbodies. The resultant pollutant loads are linked to the land uses and practices in the watershed. Agricultural and developed areas can have significant effects on water quality if proper best management practices are not in place. The main pollutants of concern associated with agricultural runoff are sediment, nutrients, pesticides, and bacteria. Storm water from developed areas can be contaminated with oil, grease, chlorides, pesticides, herbicides, nutrients, viruses, bacteria, metals, and sediment. In some areas, some connections to storm sewers can be illicit, which includes residences and businesses that discharge untreated wastewater to the storm sewers.

In addition to pollutants, alterations to a watershed's hydrology as a result of land use changes can detrimentally affect habitat and biological health. Imperviousness associated with developed land uses and agricultural field tiling can result in increased peak flows and runoff volumes and decreased base flow as a result of reduced ground water discharge. The increased peak flows and runoff volumes tend to increase streambank erosion. These more powerful flows have more capacity to move larger sediment particles farther, which may result in downstream sedimentation when the in-stream flow decreases and slows down. Drain tiles also transport agricultural runoff directly to ditches and streams, whereas runoff flowing over the land surface may infiltrate to the subsurface and may flow through riparian areas.

3.3.2 Erosion

Sedimentation and siltation were identified as causes of impairment for several streams in the project area. For sedimentation (i.e., deposition of sediment) to occur, a source of sediment must be present. Various forms of erosion are a common source of sediment. Typically, erosion will increase as stream velocity and peak flow increases. Runoff over impervious surfaces and through agricultural drain tiles will have higher velocities and peak flows, and thus, increase erosion.

Sheet erosion is the detachment of soil particles by raindrop impact, and their removal by water flowing overland as a sheet instead of in channels or rills. Rill erosion refers to the development of small, ephemeral concentrated flow paths, which function as both sediment source and sediment delivery systems for erosion on hillsides. Sheet and rill erosion occur more frequently in areas that lack or have sparse vegetation. Bank and channel erosion refers to the wearing away of the banks and channel of a stream or river. High rates of bank and channel erosion can often be associated with water flow and sediment dynamics being out of balance that can result from land use activities that either alter flow regimes, adversely affect the floodplain and streamside riparian areas, or a combination of both. Hydrology is a major driver for both sheet/rill and stream channel erosion.

3.3.3 Onsite Wastewater Treatment Systems

Onsite wastewater treatment systems (e.g., septic systems) that are properly designed and maintained should not serve as a source of contamination to surface waters. However, onsite systems do fail for a variety of reasons. Common soil-type limitations which contribute to failure include seasonally high water tables, compact glacial till, bedrock, and fragipan. When these septic systems fail hydraulically (surface breakouts) or hydrogeologically (inadequate soil filtration) there can be adverse effects to surface waters (Horsely and Witten 1996). Septic systems contain all the water discharged from homes and business and can be significant sources of pollutants. County health departments were contacted for information on septic systems and unsewered communities. Responses were received from Effingham and Christian Counties. Effingham County reported that 4,682 septic systems have been installed in the county since the 1970s, with an average of 10 failure complaints per year. Christian County did not provide information on septic systems. County-wide estimates from the National Environmental Service Center for 1992 and 1998 and though direct correspondence with Effingham County were area weighted to estimate the number of septic systems in each watershed (Table 13). An estimated 19,835 septic systems are in the watershed and the septic system density is 12.6 per square mile.

Table 13. Estimated (area weighted) septic systems

Watershed	Segment	Number of septic systems	Septic systems per square mile
Kaskaskia River	IL_O-02	6,356	13
Kaskaskia River	IL_O-15	6,801	13
Beck Creek	IL_OQ-01	2,074	10
West Okaw River	IL_OT-02	2,045	14
West Okaw River	IL_OT-04	1,043	14
Jonathon Creek	IL_OU-01	922	16
Lake Fork	IL_OW-01	2,180	13
Lake Fork	IL_OW-02	1,947	13
Asa Creek	IL_OZZT-01	244	16

Source: NESC 1992 and 1998 (data obtained from EPA Region 5 STEPL Model database)

3.3.4 Animal Feeding Operations (AFOs)

Animal feeding operations that are not classified as CAFOs are known as animal feeding operations (AFOs) in Illinois. Non-CAFO AFOs are considered nonpoint sources by U.S. EPA. AFOs in Illinois do not have state permits. However, they are subject to state livestock waste regulations and may be inspected by the Illinois EPA, either in response to complaints or as part of the Agency's field inspection responsibilities to determine compliance by facilities subject to water pollution and livestock waste regulations.

The animals raised in AFOs produce manure that is stored in pits, lagoons, tanks and other storage devices. The manure is then applied to area fields as fertilizer. When stored and applied properly, this beneficial re-use of manure provides a natural source for crop nutrition. It also lessens the need for fuel and other natural resources that are used in the production of fertilizer. AFOs, however, can pose environmental concerns, including the following:

- Manure can leak or spill from storage pits, lagoons, tanks, etc.
- Improper application of manure can contaminate surface or ground water.
- Manure over application can adversely impact soil productivity.

Livestock are potential sources of bacteria and nutrients to streams, particularly when direct access is not restricted and/or where feeding structures are located adjacent to riparian areas. Watershed specific data are not available for livestock populations. However, county wide data available from the 2012 Census of Agriculture were downloaded and area weighted to estimate the animal population in the watershed (Table 14). An estimated 100,228 animals are in the watershed.

Table 14. Estimated (area weighted) livestock animals

Watershed	Segment	Cattle	Poultry	Sheep	Hogs	Horses
Kaskaskia River	IL_O-02	6,282	7,786	223	3,048	1,131
Kaskaskia River	IL_O-15	6,557	8,124	253	3,146	1,222
Beck Creek	IL_OQ-01	3,969	221	211	16,150	127
West Okaw River	IL_OT-02	807	992	99	352	262
West Okaw River	IL_OT-04	340	413	46	108	109
Jonathon Creek	IL_OU-01	611	809	66	238	210
Lake Fork	IL_OW-01	1,482	1,714	65	808	235
Lake Fork	IL_OW-02	948	807	57	607	106
Asa Creek	IL_OZZT-01	163	222	18	67	58

Source: 2012 Census of Agriculture (Illinois)

4. TMDL Endpoints and LRS Targets

This section presents information on the water quality impairments within the Upper Kaskaskia River watershed and the associated water quality standards (WQS) and targets.

4.1 Applicable Standards

WQS are designed to protect beneficial uses. The authority to designate beneficial uses and adopt WQS is granted through Title 35 of the Illinois Administrative Code. Designated uses to be protected in surface waters of the state are defined under Section 303, and WQS are designated under Section 302 (Water Quality Standards). Designated uses and water quality criteria are discussed below.

4.1.1 Designated Uses

Illinois EPA uses rules and regulations adopted by the Illinois Pollution Control Board (IPCB) to assess the designated use support for Illinois waterbodies. The following are the use support designations provided by the IPCB that apply to water bodies in the Upper Kaskaskia River watershed:

General Use Standards – These standards protect for aquatic life, wildlife, agricultural uses, primary contact (where physical configuration of the waterbody permits it, any recreational or other water use in which there is prolonged and intimate contact with the water involving considerable risk of ingesting water in quantities sufficient to pose a significant health hazard, such as swimming and water skiing), secondary contact (any recreational or other water use in which contact with the water is either incidental or accidental and in which the probability of ingesting appreciable quantities of water is minimal, such as fishing, commercial and recreational boating, and any limited contact incident to shoreline activity), and most industrial uses. These standards are also designed to ensure the aesthetic quality of the state's aquatic environment.

4.1.2 Water Quality Criteria and TMDL Endpoints

Environmental regulations for the State of Illinois are contained within the Illinois Administrative Code, Title 35. Specifically, Title 35, Part 302 contains water quality standards promulgated by the Illinois Pollution Control Board. This section presents the standards applicable to impairments within the study area. Water quality standards and TMDL endpoint to be used for TMDL development in the Upper Kaskaskia River watershed are listed in Table 15. Impairments of primary contact recreation and aquatic life designated uses are present in the watershed.

Table 15. Summary of water quality standards for the Upper Kaskaskia River watershed

Parameter	Units	General Use Water Quality Standard
Fecal Coliform [a]	#/100 ml	400 in <10% of samples [b]
		Geometric mean < 200 [c]
Dissolved Oxygen [d]	mg/L	For most waters: March-July > 5.0 min. and > 6.0- 7-day mean Aug-Feb > 3.5 min, > 4.0- 7-day mean and > 5.5- 30-day mean For enhanced protection waters (OT-04 only): March-July > 5.0 min. and > 6.25- 7-day mean Aug-Feb > 4.0 min, > 4.5- 7-day mean and > 6.0- 30-day mean
pH	s.u.	Within the range of 6.5 – 9.0 except for natural causes
Sedimentation / Siltation	N/A	No numeric standard
Total Phosphorus	N/A	No numeric standard

a. Fecal coliform standards are applicable for the recreation season only (May through October).
b. Standard shall not be exceeded by more than 10% of the samples collected during a 30 day period.
c. Geometric mean based on minimum of 5 samples taken over not more than a 30 day period.
d. Applies to the dissolved oxygen concentration in the main body of all streams, in the water above the thermocline of thermally stratified lakes and reservoirs, and in the entire water column of unstratified lakes and reservoirs. Enhanced dissolved oxygen criteria are found in 35 Ill Adm. Code 302.206, including the list of waters with enhanced dissolved oxygen protection and methods for assessing attainment of dissolved oxygen minimum and mean values

According to Illinois water quality standards, primary contact means *...any recreational or other water use in which there is prolonged and intimate contact with the water involving considerable risk of ingesting water in quantities sufficient to pose a significant health hazard, such as swimming and water skiing* (35 Ill. Adm. Code 301.355). The assessment of primary *contact* use is based on fecal coliform bacteria data. The General Use Water Quality Standard for fecal coliform bacteria specifies that during the months of May through October, based on a minimum of five samples taken over not more than a 30-day period, fecal coliform bacteria counts shall not exceed a geometric mean of 200/100 ml, nor shall more than 10 percent of the samples during any 30-day period exceed 400/100 ml (35 Ill. Adm. Code 302.209). This standard protects primary contact use of Illinois waters by humans.

Due to limited state resources, fecal coliform bacteria is not normally sampled at a frequency necessary to apply the General Use standard, i.e., at least five times per month during May through October, and very little data available from others are collected at the required frequency. Therefore, assessment guidelines are based on application of the standard when sufficient data is available to determine standard exceedances; but, in most cases, attainment of primary contact use is based on a broader methodology intended to assess the likelihood that the General Use standard is being attained.

To assess primary contact use, Illinois EPA uses all fecal coliform bacteria from water samples collected in May through October, over the most recent five-year period (i.e., 2011 through 2015 for this report). Based on these water samples, geometric means and individual measurements of fecal coliform bacteria are compared to the concentration thresholds in Table 16 and Table 17. To apply the guidelines, the geometric mean of fecal coliform bacteria concentration is calculated from the entire set of May through October water samples, across the five years. No more than 10% of all the samples may exceed 400/100 ml for a water body to be considered Fully Supporting.

Table 16. Guidelines for Assessing Primary Contact Use in Illinois Streams and Inland Lakes

Degree of Use Support	Guidelines
Fully Supporting (Good)	No exceedances of the fecal coliform bacteria standard in the last five years and the geometric mean of all fecal coliform bacteria observations ≤200/100 ml, and ≤10% of all observations exceed 400/100 ml.
Not Supporting (Fair)	One exceedance of the fecal coliform bacteria standard in the last five years (when sufficient data is available to assess the standard) or The geometric mean of all fecal coliform bacteria observations in the last five years ≤200/100 ml, and >10% of all observations in the last five years exceed 400/100 ml or The geometric mean of all fecal coliform bacteria observations in the last five years >200/100 ml, and ≤25% of all observations in the last five years exceed 400/100 ml.
Not Supporting (Poor)	More than one exceedance of the fecal coliform bacteria standard in the last five years (when sufficient data is available to assess the standard) or The geometric mean of all fecal coliform bacteria observations in the last five years >200/100 ml, and >25% of all observations in the last five years exceed 400/100 ml

Table 17. Guidelines for Identifying Potential Causes of Impairment of Primary Contact Use in Illinois Streams and Freshwater Lakes

Potential Cause	Basis for Identifying Cause - Numeric Standard[1]
Fecal Coliform	Geometric mean of at least five fecal coliform bacteria observations collected over not more than 30 days during May through October >200/100 ml or > 10% of all such fecal coliform bacteria observations exceed 400/100 ml or Geometric mean of all fecal coliform bacteria observations (minimum of five samples) collected during May through October >200/100 ml or > 10% of all fecal coliform bacteria observation exceed 400/100 ml.

1. The applicable fecal coliform standard (35 Ill. Adm. Code, 302, Subpart B, Section 302.209) requires a minimum of five samples in not more than a 30-day period. However, because this number of samples is seldom available in this time frame, the criteria are also based on a minimum of five samples over the most recent five-year period.

Aquatic life use assessments in streams are typically based on the interpretation of biological information, physicochemical water data and physical-habitat information from the Intensive Basin Survey, Ambient Water Quality Monitoring Network or Facility-Related Stream Survey programs. The primary biological measures used are the fish Index of Biotic Integrity (fIBI; Karr et al. 1986; Smogor 2000, 2005), the macroinvertebrate Index of Biotic Integrity (mIBI; Tetra Tech 2004) and the Macroinvertebrate Biotic Index (MBI; Illinois EPA 1994). Physical habitat information used in assessments includes quantitative or qualitative measures of stream bottom composition and qualitative descriptors of channel and riparian conditions. Physicochemical water data used include measures of ―conventional parameters (e.g., dissolved oxygen, pH and temperature), priority pollutants, non-priority pollutants, and other pollutants

(USEPA 2002 and www.epa.gov/waterscience/criteria/wqcriteria.html). In a minority of streams for which biological information is unavailable, aquatic life use assessments are based primarily on physicochemical water data.

When a stream segment is determined to be Not Supporting aquatic life use, generally, one exceedance of an applicable Illinois water quality standard (related to the protection of aquatic life) results in identifying the parameter as a potential cause of impairment. Additional guidelines used to determine potential causes of impairment include site-specific standards (35 Ill. Adm. Code 303, Subpart C), or adjusted standards (published in the Illinois Pollution Control Board's Environmental Register at http://www.ipcb.state.il.us/ecll/environmentalregister.asp).

4.2 Load Reduction Strategy Targets

As described below, load reduction strategy (LRS) targets are defined for sediment and phosphorus which are lacking numeric criteria (Table 18).

Table 18. Load reduction strategies targets

LRS Parameter	Stream Water Quality Targets
Phosphorus, Total (mg/L)	0.312
Suspended Solids, Total (mg/L)	27.75
Non-Volatile Suspended Solids (mg/L)	25.82

To arrive at water quality targets to support LRSs, Illinois EPA completed the following three tasks: Identification, Analysis, and Application.

Identification:

1. For each TMDL watershed, the US Geological Survey ten-digit Hydrologic Unit Code, or HUC10 was identified.
2. Within each HUC10, each and every stream segment or lake was identified.
3. Each stream segment or lake was checked against the Illinois EPA Assessment Data Base (or ADB) to determine those segments and lakes that are in full support for aquatic life.
4. For each HUC10 basin, full-support stream segments and lakes were grouped to show where each unique watershed is at its best in providing a healthy environment for aquatic plants and animals. A statewide “one size fits all” approach was purposefully avoided to allow the distinct nature of each watershed to become apparent.

Analysis:

1. For each stream segment or lake that fully supports designated uses, the water quality data from 2001 through 2013 were compiled. This includes data from the Illinois EPA’s Surface Water Section’s ambient monitoring, intensive basin surveys, and special studies. The pollutants (or parameters) for which data compiled data are total phosphorus, total suspended solids, and non-volatile suspended solids, those pollutants requiring an LRS be developed.
2. These data underwent a quality control check and carefully discriminated against any data that did not pass the rigorous quality assurance checks. Only the data that passed all checks were used to calculate the water quality targets.
3. Mathematical operations were kept to a minimum in order to establish targets which are as accurate and relevant as possible. For each stream segment, the raw average of all available data from 2001 through 2013 was calculated for each parameter.

Application:

1. For each stream segment, an average concentration for total phosphorus, non-volatile suspended solids, and/or total suspended solids over the entire time period was calculated.
2. Within each unique watershed, these long-term results for all the fully supporting segments and streams in the watershed were averaged. This allows the healthy waters to most accurately represent the level of aquatic life support the watershed is capable of providing.
3. The average concentrations for the aquatic-life-supporting streams were then assigned as targets for all remaining streams in the watershed. The rationale for assigning this average is that within a given watershed, all streams, for example, share similar geology, soil type, land use, agricultural practices, and topography.

Finally, the average of these long-term concentrations can be used as the target concentrations for impaired stream segments requiring an LRS be developed.

5. Data Analysis

An important step in the TMDL and LRS development process is the review of water quality conditions, particularly data and information used to list segments. Examination of water quality monitoring data is a key part of defining the problem that the TMDL or LRS is intended to address. This section provides a brief review of available water quality information provided by the Illinois EPA and USGS. All relevant available data are presented below; however data that are greater than 10 years old are not used when evaluating impairment status. Each data point was reviewed to ensure the use of quality data in the analysis below.

5.1 Kaskaskia River

The Kaskaskia River is listed as being impaired along two segments – O-02 and O-15. Segment O-02 is impaired for primary contact recreation due to fecal coliform. Segment O-15 is downstream of O-02 and is also listed as impaired due to fecal coliform. There is one Illinois EPA sampling site on each of the impaired reaches.

One hundred fecal coliform samples have been collected at O-02 between 1990 and 2010 and 88 samples have been collected at O-15 between 1990 and 2006 (Figure 13 and Figure 14). However, all samples collected are greater than 5 years old. Since more recent data have not been collected on segments O-02 and O-15, additional data collection is recommended to confirm impairment. Section 6.2 discusses specific information relevant to additional data collection.

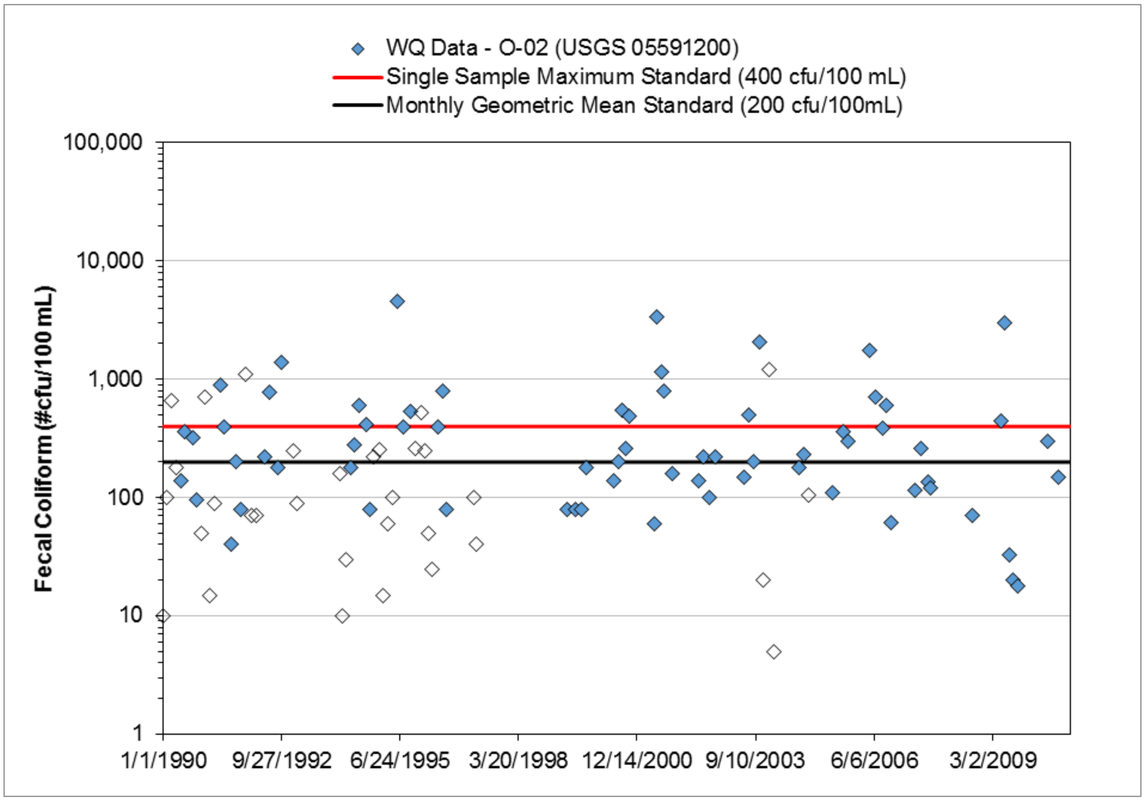

Figure 13. Fecal coliform water quality time series, Kaskaskia River O-02 segment. Unfilled points indicate samples outside the standard window.

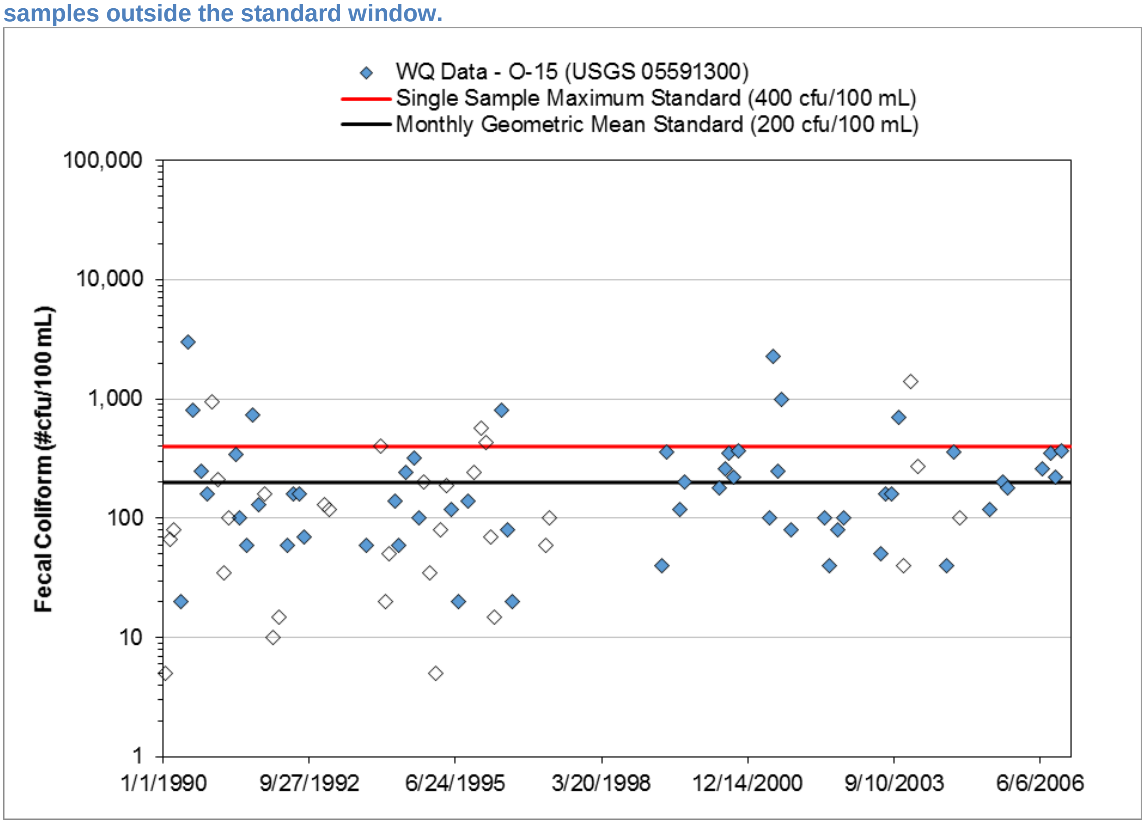

Figure 14. Fecal coliform water quality time series, Kaskaskia River O-15 segment. Unfilled points indicate samples outside the standard window.

Possible causes for high bacteria concentrations within O-02 and O-15 are upstream sewage treatment plants, livestock, and onsite wastewater treatment systems. Wildlife can also contribute to impairment, however less than 3 percent of the watershed consists of forest, grassland, and wetlands and therefore is not considered a significant source. One point source is located in the direct drainage area of these segments, and six others are located upstream of the impaired segments. In addition to STPs, AFOs and onsite wastewater treatment systems are present within the impairment watersheds. In total, it is estimated that there are approximately 40 livestock animal units and 13 onsite wastewater treatment systems per square mile potentially contributing fecal coliform to the watershed.

5.2 Beck Creek (OQ-01)

Beck Creek (OQ-01) is listed as being impaired for primary contact recreation due to fecal coliform. One Illinois EPA sampling site was identified on Beck Creek, OQ-01. Thirteen samples have been collected at the site from 2011-2015 (Table 19 and Figure 15). There are 2 reported exceedances of the 400 cfu/100 mL standard, with an average reported value above the standard at 409 cfu/100 mL. Historical data collected at site OQ-01 from 1990-2010 have an average fecal coliform concentration of 1,475 cfu/100 mL, well above the standard. Recreational use impairment is verified in this this stream.

Table 19. Data summary, Beck Creek OQ-01

Sample Site	No. of samples	Minimum (cfu/100 mL)	Average (cfu/100 mL)	Maximum (cfu/100 mL)	CV (standard deviation/ average)	Number of exceedances of single sample maximum standard (400 cfu/100 mL)
Fecal Coliform						
OQ-01 (USGS 05592195)	13	2	409	3,300	2.07	2
OQ-01 (USGS 05592195)[a]	93	5	1,475	36,000	3.37	28

a. Data from 1990-2010; greater than 5 years old.

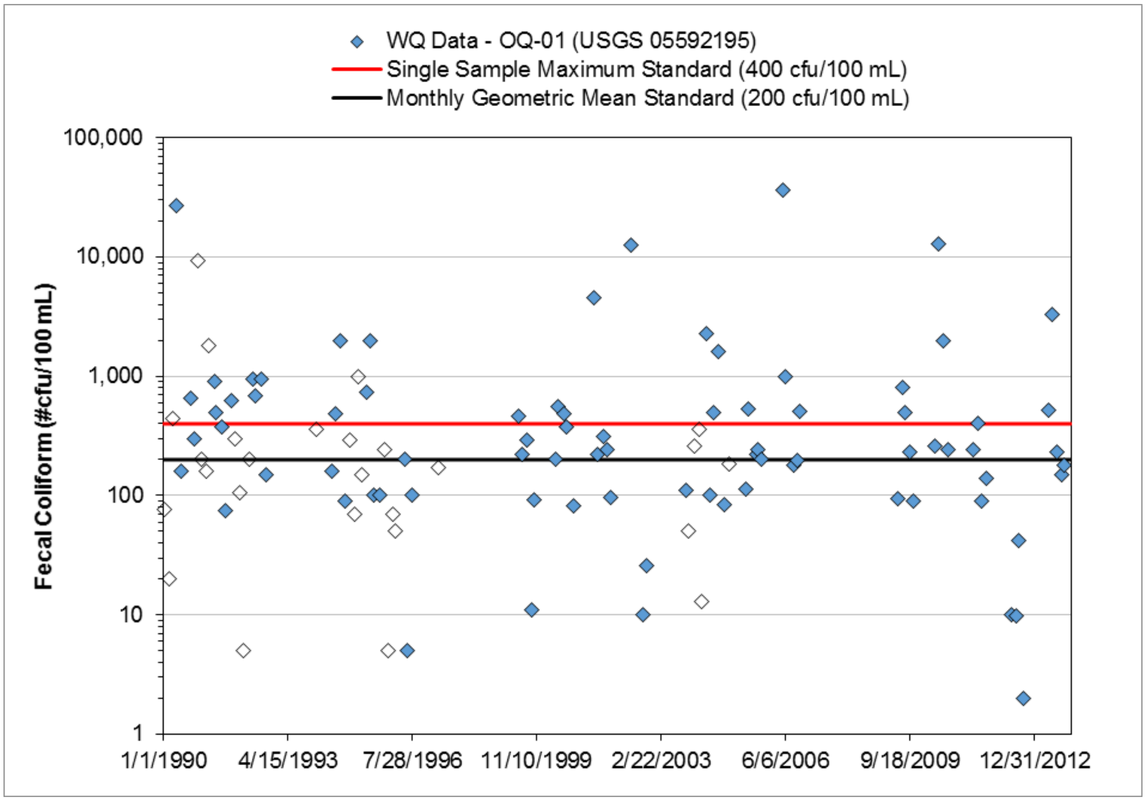

Figure 15. Fecal coliform water quality time series, Beck Creek OQ-01. Unfilled points indicate samples outside the standard window.

Possible bacteria sources within the watershed include livestock and onsite wastewater treatment systems. It is estimated that cattle and pigs make up the majority of the livestock in the Beck Creek watershed with a combined 100 animal units per square mile. In comparison, the density of onsite wastewater treatment systems is also estimated to be relatively high at 10 systems per square mile. Though not necessarily directly discharging to Beck Creek, the total number and density of both of these sources can potentially produce a large amount of fecal coliform within the watershed. Wildlife may also contribute to high fecal coliform concentrations.

5.3 West Okaw River

The West Okaw River is listed as being impaired along two segments: OT-04 and OT-02. OT-04 is listed as impaired for aquatic life due to low dissolved oxygen, elevated levels of phosphorus, and pH outside the range of general use water quality standards. OT-02 is downstream of OT-04 and is listed as impaired for primary contact recreation due to fecal coliform. There is one Illinois EPA sampling site located on impairment OT-02 (OT-02) and no Illinois EPA sampling sites located on OT-04.

5.3.1 OT-04

This segment was originally assessed for the 2006 303d List based on data collected on downstream station OT-02. No recent assessments have been made based on data collected on OT-04. During the 2010 assessment (2010 303(d) List) for segment OT-02, Aquatic Life Use was listed as Full Support and DO, pH, and phosphorus were been removed however segment OT-04 was not updated accordingly. Additional review of the data in 2016 also identified errors in the dataset for DO, conductivity, and pH.

Based on this information, segment OT-04 will be corrected by delisting the causes of DO, pH, and phosphorus, and therefore no TMDL will be developed.

5.3.2 OT-02

Eighty-six (86) fecal coliform samples have been collected at OT-02 from 1990-2006 (Figure 16). However, all samples collected are greater than 5 years old. Since more recent data have not been collected on the segment, additional data collection is recommended to confirm impairment. Section 6.2 discusses specific information relevant to additional data collection.

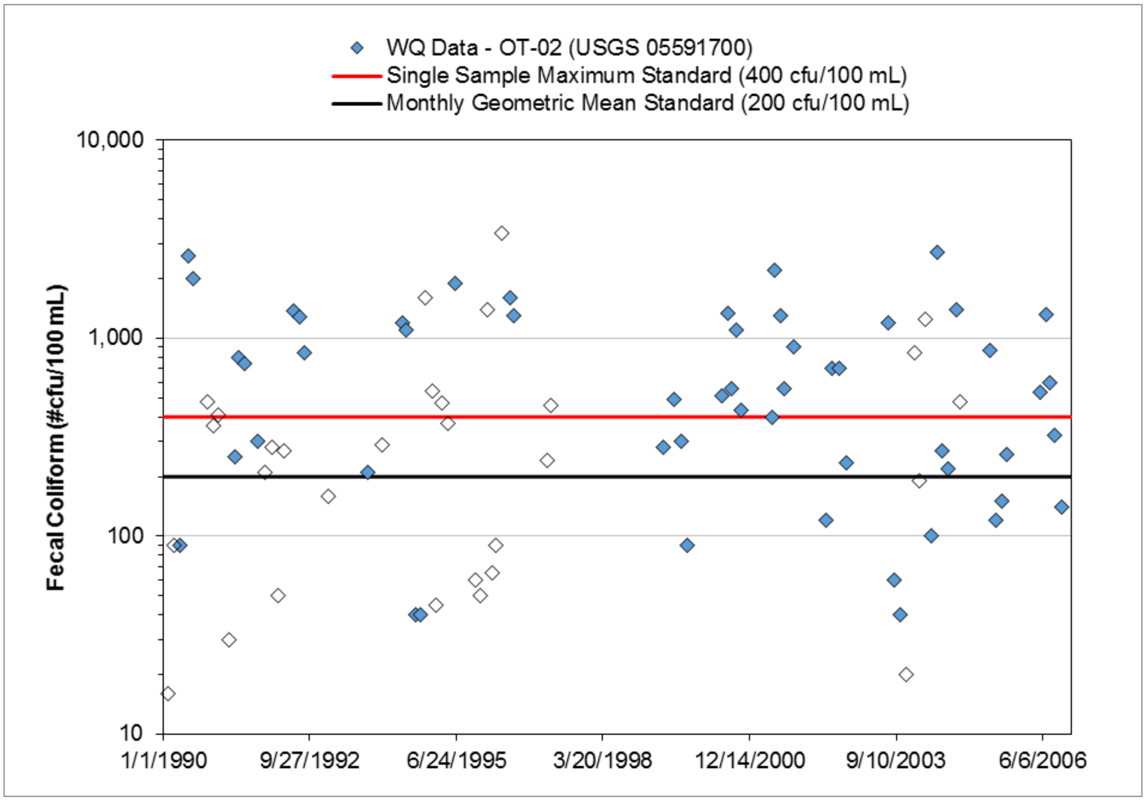

Figure 16. Fecal coliform water quality time series, West Okaw River OT-02. Unfilled points indicate samples outside the standard window.

Potential sources of bacteria include both the Lovington STP (IL0024210) and Village of Hammond STP (IL0027197; no fecal coliform permit limit), livestock, onsite wastewater treatment systems, and wildlife. The Lovington STP will be required to reduce fecal coliform concentrations as part of a new permit expected to be issued in 2016. Though neither STP drains directly to West Okaw River, any high outputs of fecal coliform from the STPs could raise the concentration in the river. In addition to STPs, it is estimated that there are approximately 14 onsite wastewater treatment systems and 15 animal units per square mile in the impairment watershed. Both of these sources can potentially produce a large amount of fecal coliform within the watershed and increase the total amount reaching the river.

5.4 Johnathon Creek (OU-01)

Johnathon Creek (OU-01) is listed as being impaired for primary contact recreation due to fecal coliform. One Illinois EPA sampling site was identified on Johnathon Creek, OU-01. 91 fecal coliform samples have been collected at the site from 1990-2006 (Figure 17). All samples collected are greater than 5 years old, additional data collection is recommended to confirm impairment. Section 6.2 discusses specific information relevant to additional data collection.

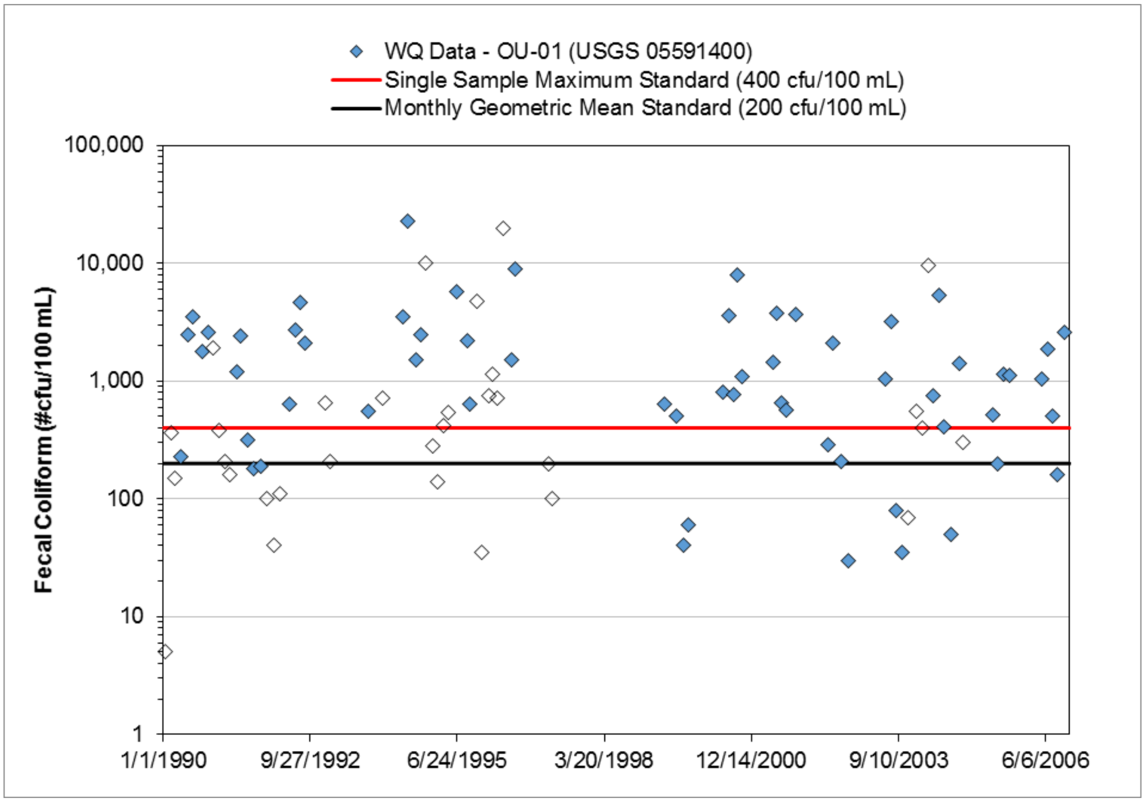

Figure 17. Fecal coliform water quality time series, Johnathon Creek OU-01. Unfilled points indicate samples outside the standard window.

Possible bacteria sources within the watershed include onsite wastewater treatment systems, livestock, and wildlife. It is estimated that there are a total of 16 onsite wastewater treatment systems and 40 animal units per square mile potentially contributing fecal coliform to the impairment watershed. Though not necessarily directly discharging to Johnathon Creek, the total number and density of both of these sources can produce a large amount of fecal coliform within the watershed.

5.5 Lake Fork (OW-01 and OW-02)

Lake Fork is listed as being impaired along two segments: OW-01 and OW-02. OW-02 is impaired for aquatic life use with elevated sediment and siltation. OW-01 is downstream of OW-02 and is also listed as impaired due to elevated sediment and siltation. There is one Illinois EPA sampling site on OW-01 (OW-01) and one Illinois EPA sampling site located one mile upstream of OW-02 (OW-03). A total of eight TSS samples have been collected at OW-01 in 2007 and 2012 and a total of three samples have been collected at OW-03 in 2007 (Table 20, Figure 18 and Figure 19). All eight TSS samples collected at OW-01 exceeded the LRS stream water quality target, with an average reported value above the target at 59 mg/L. Only one of the samples at OW-03 exceeded the LRS target, with an average reported value below the target at 20 mg/L. No non-volatile suspended solids samples were available at either sampling site. Data verify TSS concentrations are above the target criteria on both segments.

Table 20. Data summary, Lake Fork OW-01 and OW-02 segments

Sample Site	No. of samples	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	CV (standard deviation/ average)	Number of exceedances of LRS stream water quality target (27.75 mg/L)
Total Suspended Solids						
OW-01	8	31	59	109	0.37	8
OW-03	3	12	20	30	0.38	1

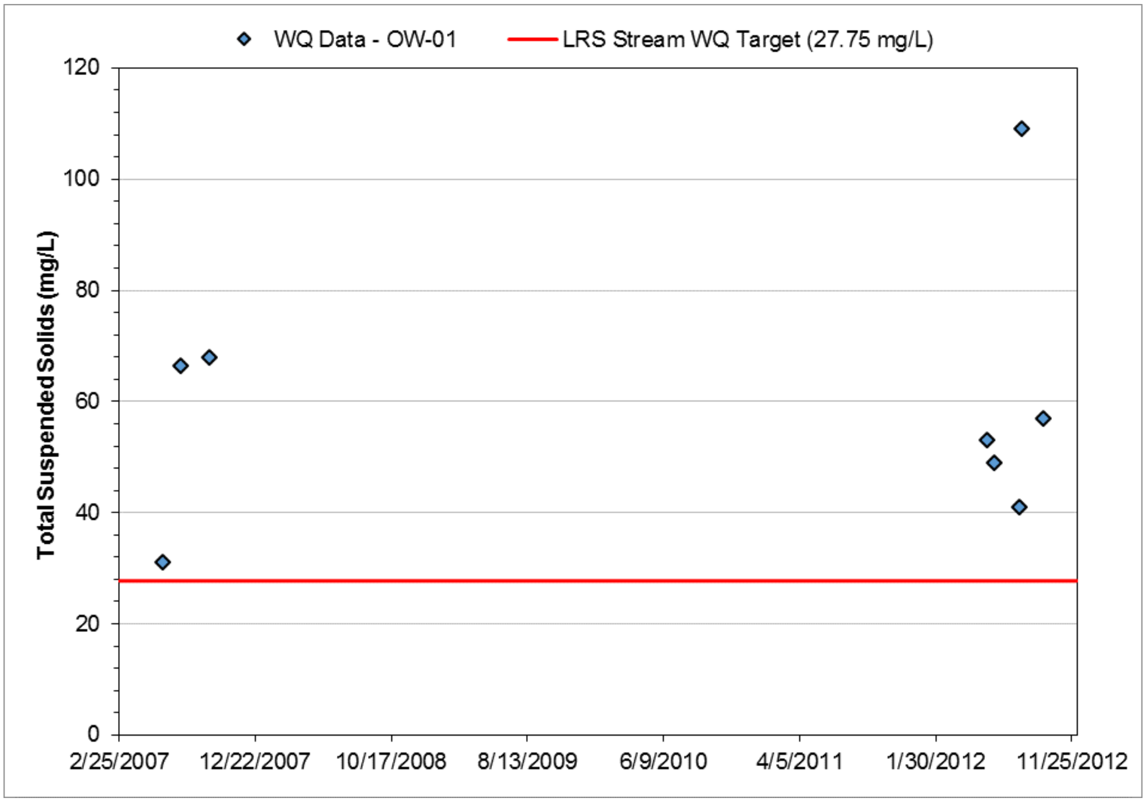

Figure 18. Total suspended solids (TSS) water quality time series, Lake Fork OW-01 segment

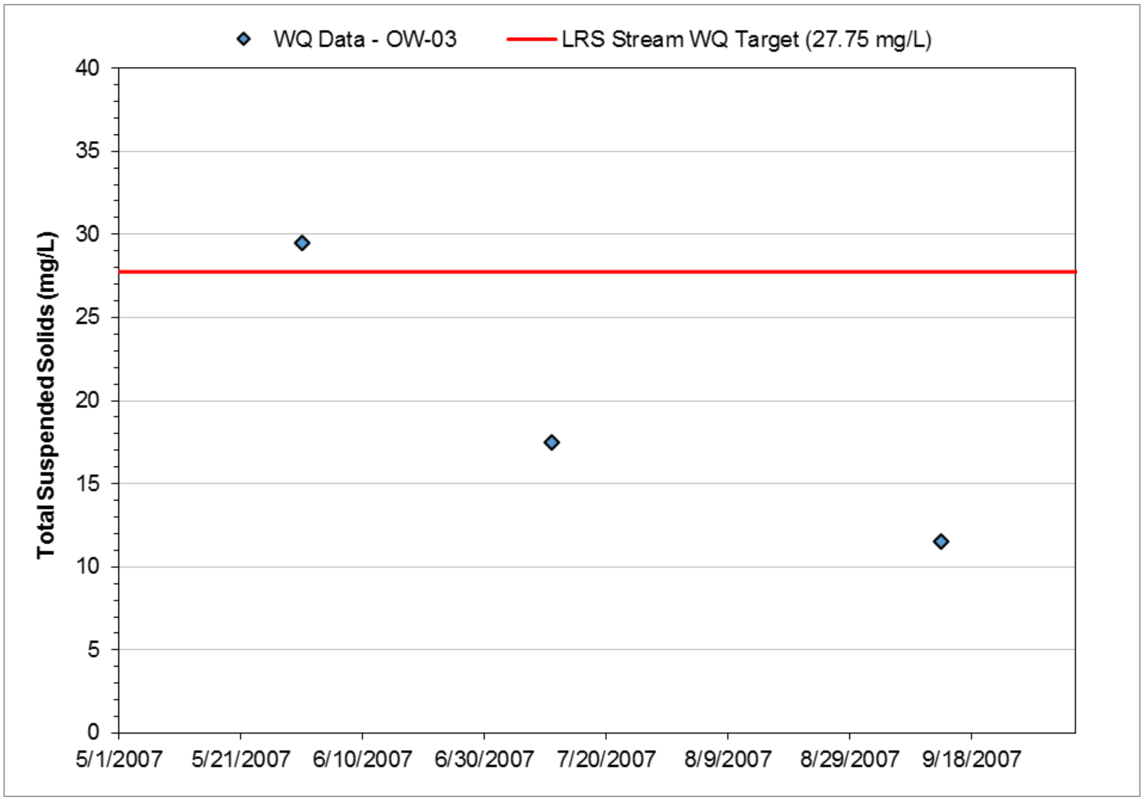

Figure 19. Total suspended solids (TSS) water quality time series, Lake Fork OW-02 segment

Possible causes for high TSS concentrations include soil erosion from of agricultural and other nonpoint source land uses and stream bank erosion. Agricultural land use accounts for 93 percent of land use in the OW-01 watershed and 94 percent in the OW-02 watershed. Altered stream channels and streambank erosion also contribute to high TSS concentrations. Noteworthy is the concentrations of TSS in the stream just upstream of the impaired segment at OW-03. This concentration is very close to the target, therefore land uses upstream of the impaired segments do not appear to be contributing to the impairment.

5.6 Asa Creek (OZZT-01)

Asa Creek is listed as being impaired for aquatic life use due to a pH range outside water quality criteria and for elevated sediment and siltation. One Illinois EPA sampling site was identified on Asa Creek, OZZT-01. Both pH and TSS data have been collected at the site from 2004-2007 (Table 21, Figure 20 and Figure 21). Of the 30 pH samples collected, only one sample was outside the general use standard range for pH of 6.5-9.0, with a value of 9.2 s.u. The sample that exceeded the pH standard was measured in the field on the morning of February 2006. No samples at OZZT-01 from between 1999 and 2003 were recorded outside of the general use standard range. An evaluation of the data suggests that the stream is not violating the pH standard, although additional data could be collected to further evaluate the impairment.

Fifteen of 28 TSS samples collected at OZZT-01 exceeded the LRS stream water quality target, with an average value above the target at 35 mg/L. Historical data collected at OZZT-01 from between 1990 and 2003have an average TSS concentration of 40 mg/L, also above the target. No NVSS samples were available at OZZT-01. Available data verify the TSS concentrations in Asa Creek are above the target.

Table 21. Data summary, Asa Creek OZZT-01

Sample Site	No. of samples	Minimum	Average	Maximum	CV (standard deviation/ average)	Number of samples outside the range of the general use water quality standard (6.5 – 9 s.u.)
pH						
OZZT-01 (USGS 05591500)	30	7.0	7.7	9.2	0.06	1
OZZT-01 (USGS 05591500)[a]	44	6.9	7.6	8.9	0.06	0
Sample Site	**No. of samples**	**Minimum**	**Average**	**Maximum**	**CV (standard deviation/ average)**	**Number of exceedances of LRS stream water quality target (27.75 mg/L)**
Total Suspended Solids						
OZZT-01 (USGS 05591500)	28	2	35	80	0.74	15
OZZT-01 (USGS 05591500)[a]	56	1	40	213	1.15	24

a. Data from 1999-2003; greater than 10 years old.
b. Data are from 1990-2003; greater than 10 years old.

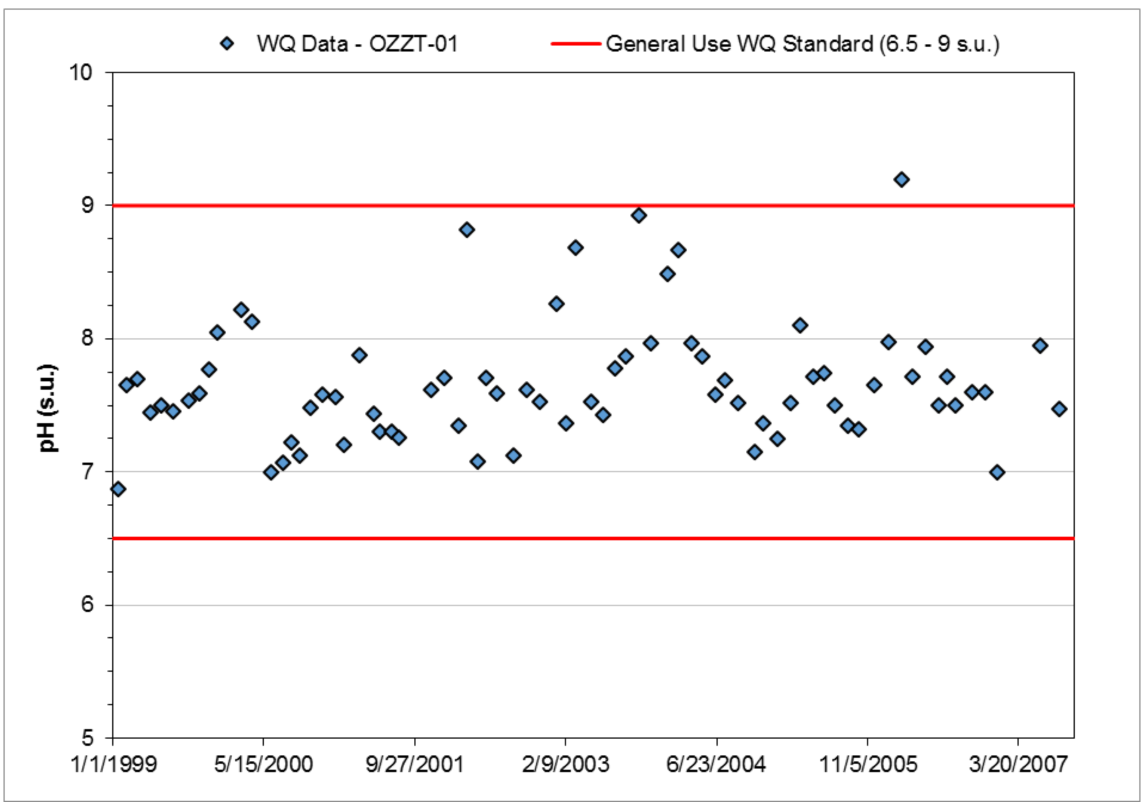

Figure 20. pH water quality time series, Asa Creek OZZT-01

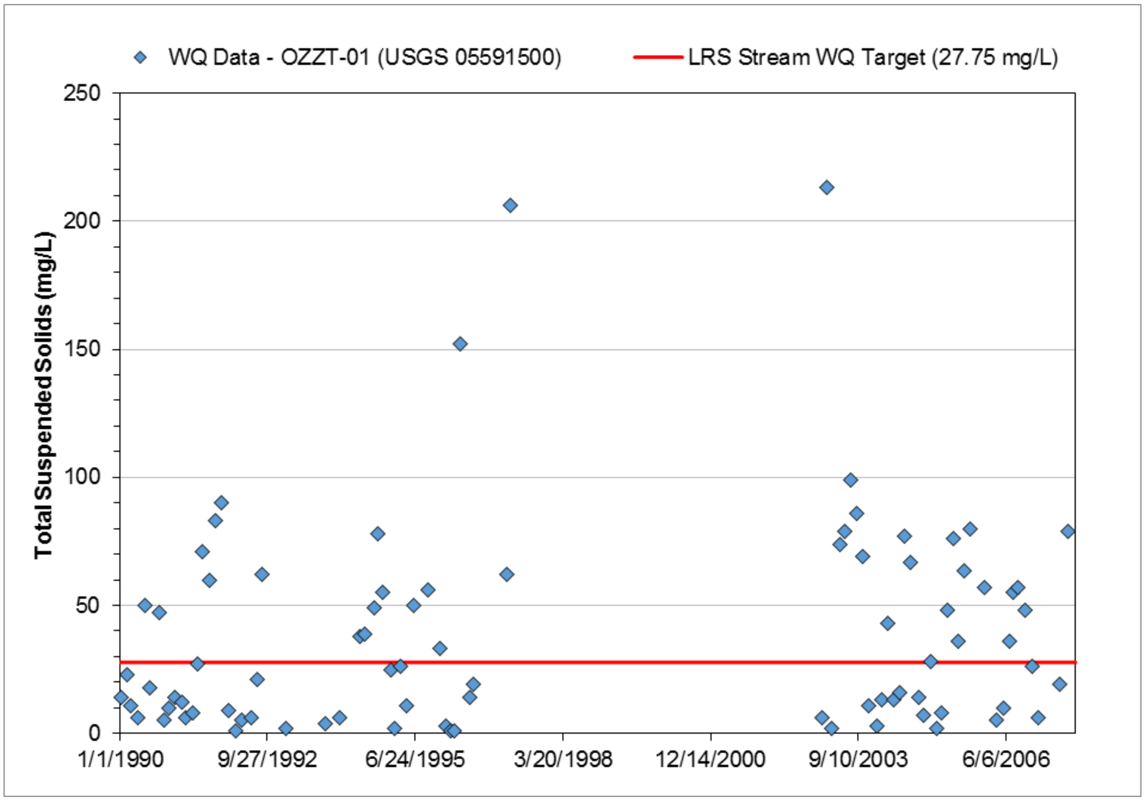

Figure 21. Total suspended solids (TSS) water quality time series, Asa Creek OZZT-01

Possible causes for high pH can include high photosynthetic activity as a result of algae or macrophytes in the creek, and possibly discharges from industrial activity. Since the only sample that exceeded the water quality standard occurred in February, agricultural activities and photosynthesis would not be probable sources. The Sullivan STP (IL0021806) discharges directly to Asa Creek and may be contributing to higher pH levels in the creek. Discharge monitoring records from the Sullivan STP do not identify exceedances of the pH standard in February 2006, but have exceeded the standard three times between 2004 and 2015.

Concentrations of TSS that are exceeding the water quality target are likely the result of soil erosion from agricultural and nonpoint source land uses and stream bank erosion. Agricultural land use accounts for 78 percent of land use in the watershed. Altered stream channels and streambank erosion also contribute to high TSS concentrations.

6. TMDL Methods and Data Needs

The first stage of this project has been an assessment of available data, followed by evaluation of their credibility. The types of data available, their quantity and quality, and their spatial and temporal coverage relative to impaired segments or watersheds drive the approaches used for TMDL model selection and analysis. Credible data are those that meet specified levels of data quality, with acceptance criteria defined by measurement quality objectives, specifically their precision, accuracy, bias, representativeness, completeness, and reliability. The following sections describe the methods that will be used to derive TMDLs and LRSs and the additional data needed to develop credible TMDLs and LRSs.

Based on expected changes to the impairment listing as described in Section 5, no TMDLs will be developed for West Okaw River (OT-04). TMDL development for the Asa Creek pH impairment will occur if additional data determines that the impairment still exists. Additional Stage 2 data may be needed to support pH TMDL development if needed.

6.1 Stream Impairments

A duration curve approach is suggested to evaluate the relationships between hydrology and water quality and calculate the TMDLs and LRSs for all pollutant-based stream impairments (i.e., fecal coliform, total phosphorus, sedimentation/siltation). Table 22 summarizes the TMDL/LRS parameter and proposed models for each impairment.

Table 22. Proposed Model Summary

Name	Segment ID	Designated Uses	TMDL or LRS Parameter(s)	Proposed Model
Kaskaskia River	IL_O-02	Primary contact recreation	Fecal coliform	Load Duration Curve
Kaskaskia River	IL_O-15	Primary contact recreation	Fecal Coliform	Load Duration Curve
Beck Creek	IL_OQ-01	Primary contact recreation	Fecal Coliform	Load Duration Curve
West Okaw River	IL_OT-02	Primary contact recreation	Fecal Coliform	Load Duration Curve
West Okaw River	IL_OT-04	Aquatic life	--	--
Jonathon Creek	IL_OU-01	Primary contact recreation	Fecal Coliform	Load Duration Curve
Lake Fork	IL_OW-01	Aquatic life	Sedimentation/Siltation	Load Duration Curve
Lake Fork	IL_OW-02	Aquatic life	Sedimentation/Siltation	Load Duration Curve
Asa Creek	IL_OZZT-01	Aquatic life	Sedimentation/Siltation	Load Duration Curve

The primary benefit of duration curves in TMDL development is to provide insight regarding patterns associated with hydrology and water quality concerns. The duration curve approach is particularly applicable because water quality is often a function of stream flow. For instance, sediment concentrations typically increase with rising flows as a result of factors such as channel scour from higher velocities. Other parameters, such as chloride, may be more concentrated at low flows and more diluted by increased water volumes at higher flows. The use of duration curves in water quality assessment creates a framework that enables data to be characterized by flow conditions. The method provides a visual display of the relationship between stream flow and water quality.

Allowable pollutant loads have been determined through the use of load duration curves. Discussions of load duration curves are presented in *An Approach for Using Load Duration Curves in the Development of TMDLs* (U.S. EPA 2007). This approach involves calculating the allowable loadings over the range of flow conditions expected to occur in the impaired stream by taking the following steps:

1. A flow duration curve for the stream is developed by generating a flow frequency table and plotting the data points to form a curve. The data reflect a range of natural occurrences from extremely high flows to extremely low flows.

2. The flow curve is translated into a load duration (or TMDL) curve by multiplying each flow value (in cubic feet per second) by the water quality standard/target for a contaminant (mg/L or count/100 mL), then multiplying by conversion factors to yield results in the proper unit (i.e., pounds per day or count/day). The resulting points are plotted to create a load duration curve.

3. Each water quality sample is converted to a load by multiplying the water quality sample concentration by the average daily flow on the day the sample was collected. Then, the individual loads are plotted as points on the TMDL graph and can be compared to the water quality standard/target, or load duration curve.

4. Points plotting above the curve represent deviations from the water quality standard/target and the daily allowable load. Those plotting below the curve represent compliance with standards and the daily allowable load. Further, it can be determined which locations contribute loads above or below the water quality standard/target.

5. The area beneath the TMDL curve is interpreted as the loading capacity of the stream. The difference between this area and the area representing the current loading conditions is the load that must be reduced to meet water quality standards/targets.

6. The final step is to determine where reductions need to occur. Those exceedances at the right side of the graph occur during low flow conditions, and may be derived from sources such as illicit sewer connections. Exceedances on the left side of the graph occur during higher flow events, and may be derived from sources such as runoff. Using the load duration curve approach allows Illinois EPA to determine which implementation practices are most effective for reducing loads on the basis of flow regime. If loads are considerable during wet-weather events (including snowmelt), implementation efforts can target those best management practices that will most effectively reduce stormwater runoff.

Water quality duration curves are created using the same steps as those used for load duration curves except that concentrations, rather than loads, are plotted on the vertical axis.

The stream flows displayed on water quality or load duration curves may be grouped into various flow regimes to aid with interpretation of the load duration curves (example shown in Figure 22). The flow regimes are typically divided into 10 groups, which can be further categorized into the following five hydrologic zones (U.S. EPA 2007):

- High flow zone: stream flows that plot in the 0 to 10-percentile range, related to flood flows.
- Moist zone: flows in the 10 to 40-percentile range, related to wet weather conditions.
- Mid-range zone: flows in the 40 to 50 percentile range, median stream flow conditions;
- Dry zone: flows in the 60 to 90-percentile range, related to dry weather flows.
- Low flow zone: flows in the 90 to 100-percentile range, related to drought conditions.

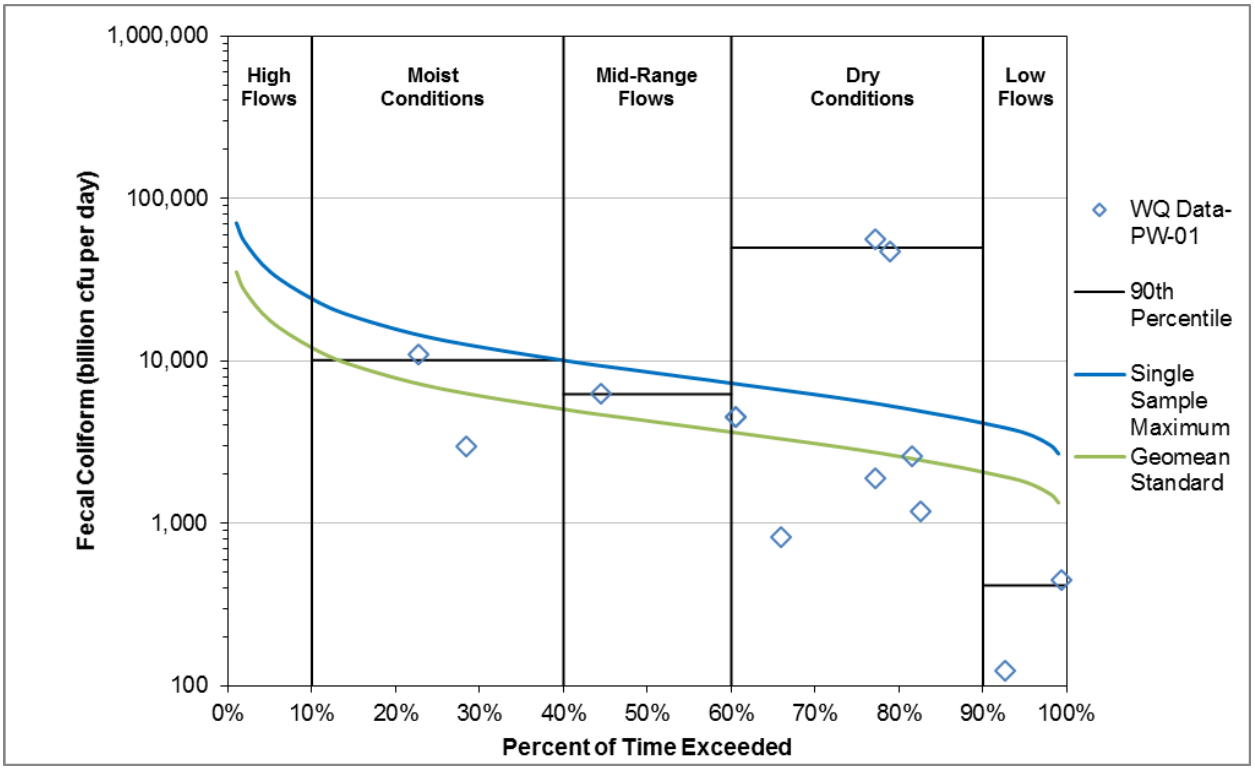

Figure 22. Example load duration curve for fecal coliform.

The duration curve approach helps to identify the issues surrounding the impairment and to roughly differentiate between sources. Table 23 summarizes the general relationship between the five hydrologic zones and potentially contributing source areas (the table is not specific to any individual pollutant). For example, the table indicates that impacts from point sources are usually most pronounced during dry and low flow zones because there is less water in the stream to dilute their loads. In contrast, impacts from channel bank erosion is most pronounced during high flow zones because these are the periods during which stream velocities are high enough to cause erosion to occur.

Table 23. Relationship between duration curve zones and contributing sources

Contributing source area	Duration Curve Zone				
	High	Moist	Mid-range	Dry	Low
Point sources				M	H
Livestock direct access to streams				M	H
On-site wastewater systems	M	M-H	H	H	H
Riparian areas		H	H	M	
Stormwater: Impervious		H	H	H	
Stormwater: Upland	H	H	M		
Field drainage: Natural condition	H	M			
Field drainage: Tile system	H	H	M-H	L-M	
Bank erosion	H	M			

Note: Potential relative importance of source area to contribute loads under given hydrologic condition (H: High; M: Medium; L: Low).

The load reduction approach also considers critical conditions and seasonal variation in the TMDL development as required by the Clean Water Act and U.S. EPA's implementing regulations. Because the approach establishes loads on the basis of a representative flow regime, it inherently considers seasonal variations and critical conditions attributed to flow conditions. An underlying premise of the duration curve approach is correlation of water quality impairments to flow conditions. The duration curve alone does not consider specific fate and transport mechanisms, which may vary depending on watershed or pollutant characteristics.

6.2 Additional Data Needs

Data satisfy two key objectives for Illinois EPA, enabling the agency to make informed decisions about the resource. These objectives include developing information necessary to:

- Determine if the impaired areas are meeting applicable water quality standards for their respective designated use(s); and
- Support modeling and assessment activities required to allocate pollutant loadings for all impaired areas where water quality standards are not being met.

Additional data points can be needed to verify impairment, understand probable sources, calculate reductions, develop validated water quality models, and develop effective implementation plans. Table 24 summarizes each segment and the need for additional data to verify impairments and develop TMDLs/LRSs.

Table 24. Additional data needs

Name	Segment ID	Designated Uses	TMDL Parameters	LRS Parameters	Needs Additional Data?
Kaskaskia River	IL_O-02	Primary contact recreation	Fecal coliform	-	Yes – 5 samples over a 30-day period s
Kaskaskia River	IL_O-15	Primary contact recreation	Fecal Coliform	-	Yes – 5 samples over a 30-day period
Beck Creek	IL_OQ-01	Primary contact recreation	Fecal Coliform	--	Yes – 5 samples over a 30-day period
West Okaw River	IL_OT-02	Primary contact recreation	Fecal Coliform	--	Yes – 5 samples over a 30-day period
West Okaw River	IL_OT-04	Aquatic life	*Dissolved Oxygen, pH*	*Total Phosphorus*	No, parameters being delisted
Jonathon Creek	IL_OU-01	Primary contact recreation	Fecal Coliform	--	Yes – 5 samples over a 30-day period
Lake Fork	IL_OW-01	Aquatic life	--	Sedimentation/Siltation	No
Lake Fork	IL_OW-02	Aquatic life	--	Sedimentation/Siltation	No
Asa Creek	IL_OZZT-01	Aquatic life	*pH*	Sedimentation/Siltation	Yes – 5 samples to verify impairment

Italics – data indicate no impairment or no TMDL being developed

7. Public Participation

<To be updated following Stage 1 public meeting>

8. References

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